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VOLUME 2 NUMBER 22

Scientific and Technical Aerospace Reports

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November 23, 1964

01 GENERAL

Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

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TECHNICAL CYBERNETICS, NO. 3, 1964
10 Sep. 1964 361 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Tekhn. Kibernetika (USSR), no. 3, May–Jun. 1964 p 1–192
(JPRS-26336; TT-64-41595) OTS: $6.00

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1964 205 p Conf. held in Boston, 29 Apr.–1 May 1964 (NASA-SP-51) GPO: $1.50

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N64-30327* National Aeronautics and Space Administration, Washington, D.C.
TO SAIL THE NEW OCEAN OF SPACE
Hugh L. Dryden *In its* Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 7–11 (See N64-30326 22-01) GPO: $1.50

The history and current status of the U.S. space effort are discussed. Many of the necessary tools have been developed, and the Nation now has the capability of doing many more missions than available resources will permit. The speaker warns against repeating the mistake of the past in advanced-area research and development. The mistake is that of repeated preoccupation with the current requirements of the Nation at the expense of, or to the neglect of, the basic long-range effort needed to maintain leadership in vital areas of science and technology. The reasons for the manned lunar-landing project are enumerated. R.L.K.

N64-30328* Little (Arthur D.) Inc., Cambridge, Mass.
THE SPACE PROGRAM AND NEW ENGLAND INDUSTRY
James M. Gavin *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 13–16 (See N64-30326 22-01) GPO: $1.50

The importance of civilian use of the newly acquired space knowledge is discussed. The possibility of the space program as an alternative to the waning defense market is mentioned. There are three advantages offered to the New England economy—the dollars brought by space contracts, the generation of new knowledge and technology, and the pool of talent brought to the area. The need for achieving a balance with civilian production is stressed. R.L.K.

N64-30329* Massachusetts Inst. of Tech., Cambridge
NEW ENGLAND: A RESEARCH-RELIANT REGION
J. R. Killian, Jr. *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 17–20 (See N64-30326 22-01) GPO: $1.50

The interrelations of the National Space Program with education are considered. Expenditures by NASA at universities are now about $90 million a year. Over 4,000 experimenters in

universities are participating in NASA-sponsored research. New England educational institutions are participating in the training-grant program, using grants-in-aid for construction of laboratory facilities, and receiving special interdisciplinary research grants. They have undertaken over 75 specific research and development projects with NASA support. The need for increasing the graduate capacity of the university system is stressed, as is the need for postdoctoral study, in-service education, and strengthening of the precollege schools. R.L.K.

N64-30330* Congress. House. Committee on Science and Astronautics
HOW CONGRESS DEALS WITH SCIENCE AND TECHNOLOGY
Emilio Q. Daddario *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 23–27 (See N64-30326 22-01) GPO: $1.50

Congressional interest in the science field is chiefly concerned with policy, and there is constant review to ensure that programs are set up so as to serve the national interest most fully. The need for the Congress to strengthen its own sources of information and advice on scientific and technical matters is discussed. Two problems that frequently emerge in Congress concern the geographical distribution of Federal funds for research and development, and the indirect costs that are, or should be, allowed in connection with Government research grants to universities. R.L.K.

N64-30336* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE FUTURE OF SPACE
Wernher von Braun *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 73–77 (See N64-30326 22-01) GPO: $1.50

The broad base of the U.S. space program is emphasized to make the point that it is not the sole mission of the civilian space program to put a man on the moon. The future of manned space flight cannot be predicted until considerably more experience is accumulated. The expense and pace of the program are discussed. R.L.K.

N64-30348* General Electric Co., Schenectady, N.Y. Aerospace and Defense Group
SPACE TECHNOLOGY'S POTENTIAL FOR INDUSTRY
J. S. Parker *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 213–217 (See N64-30326 22-01) GPO: $1.50

The transfer of space-technology developments to the civilian sector of the economy has a time lag, which varies in different fields. The increased ability of industry to manage larger, more complicated systems is the field in which there will be the most immediate effect. The transfer of technology will require more time and effort to convert because of the commercial climate of economic competition. As far as specific products and components are concerned, there are only a few isolated items for which the need and cost parameter are such that they are immediate candidates for transfer to commerical application; weather and communications satellites are two noteworthy examples. The importance of market development to create a need product is emphasized. R.L.K.

N64-30349* National Aeronautics and Space Administration. North Eastern Office, Cambridge, Mass.
NEW ENGLAND AND THE SPACE PROGRAM
Franklyn W. Phillips *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 219–221 (See N64-30326 22-01) GPO: $1.50

The importance of marketing is stressed as the key to a company's success in obtaining a prime contract or subcontract in the space program. R.L.K.

N64-30350* Massachusetts Inst. of Tech., Cambridge
NEW ENGLAND'S STAKE IN THE SPACE PROGRAM
James Mc Cormack *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful uses of Space 1964 p 223–225 (See N64-30326 22-01) GPO: $1.50

The suggestion is made that an innovation in management is needed if New England is to capitalize on the space program ideas created in that area. R.L.K.

N64-30451 International Scientific Radio Union (URSI) Brussels (Belgium) D.S.A. National Committee
REPORT ON THE FOURTEENTH GENERAL ASSEMBLY OF THE U.R.S.I.
Washington, Natl. Acad. of Sci.-Natl. Res. Council [1963] 645 p refs In ENGLISH and FRENCH Assembly held in Tokyo, 9–20 Sep. 1963
(NAS-NRC-1183)

CONTENTS:

1. OPENING PLENARY MEETING R. L. Smith-Rose p 3–31
2. ADMINISTRATIVE ACTIONS OF THE ASSEMBLY p 32–44
3. RESOLUTIONS AND RECOMMENDATIONS p 45–58
4. U.S. DELEGATES TO THE GENERAL ASSEMBLY p 59–73
5. SPACE RADIO RESEARCH COMMITTEE ADMINISTRATIVE SESSION p 74–82
6. SPACE RADIO RESEARCH COMMITTEE GENERAL SESSION (ALL COMMISSIONS) 83–119
7. COMMISSION I: RADIO STANDARDS AND MEASUREMENTS p 120–201 refs
8. COMMISSION II: RADIO AND TROPOSPHERE p 202–254
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10. COMMISSION IV: RADIO NOISE OF TERRESTRIAL ORIGIN p 328–357
11. COMMISSION V: RADIO ASTRONOMY p 358–450 refs
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APPENDIX

14. SOME RESULTS OF EXPERIMENTS IN THE IONOSPHERE AND INTERPLANETARY SPACE MADE IN 1961–1962 ON GEOPHYSICAL ROCKETS OF THE USSR ACADEMY OF SCIENCES, THE COSMOS 2 SATELLITE AND THE MARS 1 SPACE PROBE K. I. Gringauz p 634–650 refs (see N64-30452 22-12)
15. RESULTS FROM THE INVESTIGATIONS OF THE IONOSPHERE BY THE METHODS OF IMPULSE SOUNDING AND ARTIFICIAL SATELLITES G. G. Getmantsev and N. G. Denisov p 650–657 refs (See N64-30453 22-12)

N64-30529 RAND Corp., Santa Monica, Calif.
FUTURE TRENDS IN AIR FORCE DATA SYSTEMS
R. L. Van Horn May 1964 33 p ref
(Contract AF 49(638)-700; Proj. RAND)
(RM-3924-PR; AD-439333)

The necessity of applying data processing to the mission-critical areas of supply, maintenance, and operations management is emphasized. The problem of how to present information to the user is discussed and illustrated. The mechanization of part of the maintenance scheduling area shows the potential for such applications. The use of computer simulation models for base and command planning is described. R.L.K.

N64-30609* National Aeronautics and Space Administration, Washington, D.C.
NASA PUBLICATIONS MANUAL
1964 81 p refs
(NASA-SP-7013) GP: $0.45

This is the first draft of a publications manual for scientific and technical reports. Certain types of reports to be issued under NASA sponsorship are described. A section on format is concerned with the physical appearance and reproduction procedures, and samples are provided to illustrate setups to be followed. Subsequent sections advise authors and editors in matters relating to organization, content, and general style. R.L.K.

N64-30655 Joint Publications Research Service, Washington, D.C.
CYBERNETICS—THE SCIENCE OF OPTIMUM CONTROL
A. I. Berg 28 Sep. 1964 58 p refs Transl. into ENGLISH of the book "Kibernetika—Nauka ob Optimalnom Upravlenii" Moscow, Massovaya Radiobiblioteka, no. 525, 1964 p 1–64
(JPRS-26581; TT-64-41839)

CONTENTS:

1. INTRODUCTION p 1–3
2. THE TIME FACTOR p 4–12 ref
3. THE SCIENCE OF CONTROL p 12–17
4. CYBERNETICS AND ANIMATE NATURE p 17–26 refs
5. CYBERNETICS AND THE LIBERAL ARTS p 26–42 refs
6. CYBERNETICS AND TECHNOLOGY p 42–48 ref
7. THEORETICAL PROBLEMS OF CYBERNETICS p 48–52 ref
8. PHILOSOPHICAL PROBLEMS OF CYBERNETICS p 52–54
9. CONCLUSION p 54–56

N64-30733 Air Force Dept., Washington, D.C.
BANQUET ADDRESS: [OBJECTIVES IN SPACE]
James Ferguson *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 311–320 (See N64-20712 22-16)

In this address, the four basic reasons for going into space are identified as follows: (1) scientific; (2) national prestige; (3) defense; and (4) commercial. The most significant challenge is the decision to develop the Manned Orbiting Laboratory (MOL), which is to sustain men in space for periods up to 30 days. Each of the four basic reasons for space travel and exploration is discussed. A.W.

N64-30764* National Aeronautics and Space Administration, Washington, D.C.
ASPECTS OF THE LAW OF SPACE ACTIVITIES
Paul G. Dembling Repr. from Fed. Bar J., v. 21, no. 2, Spring 1961 p 235–244 refs Presented at the 15th Ann. Meeting of the ARS, Washington, 7 Dec. 1960
(NASA-RP-308)

Included in this report are discussions of the following: (1) the question of whether or not there is, or should be, an upward limit of territorial sovereignty; (2) the possibility of national claims to all or a portion of celestial bodies; (3) the liability of the launching nations for damage to property or injury to persons caused by artificial satellites; (4) the rights and obligations of the launching state and the host state in the case of unscheduled landings of spacecraft and personnel; (5) launchings and test firings by private organizations; (6) the disposition of the government's rights to space technological developments; and (7) international cooperation. I.v.L.

N64-31075 Naval Ordnance Lab., White Oak, Md.
AN INDUCED VOLTAGE TECHNIQUE FOR EXPLODING A PLASTIC PROJECTILE Ballistics Research Report 80
Rayner A. Montgomery and E. Eugene Kilmer Oct. 1964 22 p refs
(NOLTR 62-173)

An induced-voltage technique for exploding a plastic projectile in supersonic flight was investigated. A 40-mm projectile was launched at speeds varying from 2,000 fps to 4,000 fps. Proper initiation of the explosive train was obtained. Author

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-30401 Rensselaer Polytechnic Inst., Troy, N.Y.
RESEARCH ON THE DYNAMICS OF A VEHICLE IN A TUBE Final Progress Report
Jun. 1964 297 p refs
(Grant DA-ORD-31-124-61-G88)
(TR-AE-6406; AROD-2566-7; AD-603024)

CONTENTS:

1. AN APPROXIMATE ANALYSIS OF A SELF-PROPELLED VEHICLE IN A TUBE WITH CONSIDERATION OF VARIOUS TUBE END CONDITIONS P. Mc Grath, J. N. Burr, and W. Adair 31 p refs (See N64-30402 22-02)
2. THE EFFECT OF SIMULATED HIGH FORWARD SPEED ON A TWO-DIMENSIONAL GROUND EFFECT SUPPORT A. A. West 39 p refs (See N64-30403 22-10)
3. FLOW FIELD AROUND A HOLLOW CYLINDER MOUNTED IN A TUBE G. M. Davey, M. H. Siegel, J. W. Burr, and D. E. Cromack 64 p refs (See N64-30404 22-02)
4. MEASUREMENT OF FORCES AND MOMENTS ACTING ON A VEHICLE IN A TUBE J. W. Burr 11 p (See N64-30405 22-02)
5. WALL EFFECTS ON THE DRAG OF A BODY MOVING IN A TUBE P. N. Szucs 12 p ref (See N64-30406 22-02)
6. PROPULSION OF A VEHICLE IN A TUBE J. V. Foa 59 p refs (See N64-30407 22-02)
7. ANALYSIS OF THE WAKE OF A SELF-PROPELLED VEHICLE IN A DUCT WITH CONSIDERATION OF HEAT TRANSFER AND FRICTION D. E. Cromack and L. F. Gijsels 11 p refs (See N64-30408 22-02)
8. A NOTE ON THE FLOW INDUCED BY A DISTURBANCE TRAVELING IN A TUBE H. J. Hagerup 19 p refs (See N64-30409 22-02)
9. ON TWO PROBLEMS OF TRANSONIC NONSTEADY MOTION OF A VEHICLE IN A TUBE J. W. Burr 18 p refs (See N64-30410 22-02)

10. PRELIMINARY DESIGN CONSIDERATIONS FOR A.3-FT DIAMETER TUBE TRANSPORT PILOT MODEL L. F. Gijsels 13 p refs (See N64-30411 22-10)

11. RECOMMENDATIONS FOR FUTURE WORK J. V. Foa and R. M. Lewis 6 p (See N64-30412 22-10)

N64-30402 Rensselaer Polytechnic Inst., Troy, N.Y.

AN APPROXIMATE ANALYSIS OF A SELF-PROPELLED VEHICLE IN A TUBE WITH CONSIDERATION OF VARIOUS TUBE END CONDITIONS

Peter Mc Grath, John W. Burr, and William Adair *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 31 p refs Previously issued as TR-AE-6204 (See N64-30401 22-02)
(TR-AE-6204)

An analysis is carried out to determine the magnitude of the flow velocities that are induced inside a tube in the presence of a vehicle that propels itself by the fore-to-aft transfer, at appropriate rates, of the fluid in the adjacent layers within the tube itself. A fixed schedule of accelerations of the vehicle is considered, with various tube end conditions. The greatest induced air velocities are produced if the tube is open at both ends. If the tube is closed at one or both ends, the induced air velocities are more than an order-of-magnitude lower. In an infinite or half-infinite tube the induced air velocities are greater than those produced in a closed tube, but still an order-of-magnitude lower than those produced in a tube open at both ends. Author

N64-30404 Rensselaer Polytechnic Inst., Troy, N.Y.

FLOW FIELD AROUND A HOLLOW CYLINDER MOUNTED IN A TUBE

Gerald M. Davey, Mark H. Siegel, John W. Burr, and Duane E. Cromack *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 64 p refs Previously issued as TR-AE-6402 (See N64-30401 22-02)
(TR-AE-6402)

Preliminary tests have been carried out to investigate the pressure distribution on the outside surface of a vehicle moving at high speed within a tube. The vehicle was simulated by a hollow cylinder mounted in a tube of circular cross section. The contribution of these surfaces to the lift and pitching moment on the vehicle are determined. The contribution to pitching moment is found to be destabilizing. These tests are supplemented by flow visualization tests at low flow velocities. Author

N64-30405 Rensselaer Polytechnic Inst., Troy, N.Y.

MEASUREMENT OF FORCES AND MOMENTS ACTING ON A VEHICLE IN A TUBE

John W. Burr *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 11 p (See N64-30401 22-02)

The question as to whether a vehicle traveling in a tube would be aerodynamically stable or unstable was examined. An experimental rig for studying the aerodynamics of a vehicle in a tube is described, and some initial results are presented. In the initial results, it was found that the effect of Mach number is small over the range of Mach numbers tested, and that changing the shape of the leading edge from a rounded edge to a square blunt edge does not seem to affect appreciably the lift coefficient. P.V.E.

N64-30406 Rensselaer Polytechnic Inst., Troy, N.Y.

WALL EFFECTS OF THE DRAG OF A BODY MOVING IN A TUBE

Peter N. Szucs *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 12 p ref (See N64-30401 22-02)

Drop tests have been conducted to determine how the drag of a body moving inside a tube is affected by the tube walls. Measurements have been made for various end conditions, Reynolds numbers, body-to-duct diameter ratios, and body shapes. Only steady-state conditions have been considered. Author

N64-30407 Rensselaer Polytechnic Inst., Troy, N.Y.

PROPULSION OF A VEHICLE IN A TUBE

Joseph V. Foa *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 59 p refs Previously issued as TR-AE-6404 (See N64-30401 22-02)
(TR-AE-6404)

This study concerns the flow disturbances and energy transformations that a vehicle traveling in a tube produces in the adjacent columns of air. The analysis accounts for compressibility, friction, and heat exchanges. The results are applied to the calculation of the power required in relation to blockage ratio, vehicle speed, and mode of propulsion. At the higher speeds, the power required is found to depend very critically on the mode of propulsion. Author

N64-30408 Rensselaer Polytechnic Inst., Troy, N.Y.

ANALYSIS OF THE WAKE OF A SELF-PROPELLED VEHICLE IN A DUCT WITH CONSIDERATION OF HEAT TRANSFER AND FRICTION

Duane E. Cromack and Leo F. Gijsels *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 11 p refs (See N64-30401 22-02)

This report concerns the flow in the wake of a self-propelled vehicle traveling in an infinite tube. The analysis includes the effects of compressibility, friction, and heat transfer and makes use of the Reynolds analogy to relate the latter two effects. Author

N64-30409 Rensselaer Polytechnic Inst., Troy, N.Y.

A NOTE ON THE FLOW INDUCED BY A DISTURBANCE TRAVELING IN A TUBE

Henrik J. Hagerup *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 19 p refs (See N64-30401 22-02)

A linearized two-dimensional analysis is presented that indicates some general features of flow induced by a disturbance propagating at constant velocity along a slender tube. The formulation applies to small disturbances, includes effects of viscosity and heat conduction for gases of arbitrary Prandtl number, and neglects viscous dissipation. Typical subsonic and supersonic solutions have been calculated for the case of Prandtl number 1. Author

N64-30410 Rensselaer Polytechnic Inst., Troy, N.Y.

ON TWO PROBLEMS OF TRANSONIC NONSTEADY MOTION OF A VEHICLE IN A TUBE

John W. Burr *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 18 p refs (See N64-30401 22-01)

The determination of the distance at which a shock forms ahead of a vehicle in a tube is discussed. Also considered is the determination of the distance the shock remains ahead of the vehicle during the transition time, before it is overtaken by the vehicle. The problem of slowing down the shock and thus shortening the distance and time required for the vehicle to overtake it is also discussed. P.V.E.

N64-30422 Joint Publications Research Service, Washington, D.C.

EQUATIONS OF MOTION OF AN AXISYMMETRIC ROCKET IN CYLINDRICAL COORDINATES

V. K. Svyatodukh *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 34–46 refs (See N64-30416 22-33) OTS: $4.00

Equations of motion are obtained for an axisymmetric rocket in a cylindrical system of coordinates, suitable for the analysis of the dynamic stability during flight according to a nonballistic trajectory. In developing the equations, coordinate axes analogous to the axes of Rezal are used. Cases are cited in which, with nonlinear aerodynamic characteristics, complete motion of the rocket at small disturbances can be isolated into separate movements. An example is presented that illustrates the use of a new form of equations to investigate the spatial disturbance of the rocket motion in the presence of a banking moment, depending on the angles-of-attack and slip. Author

N64-30761 Martin Co., Orlando, Fla.
HYPERSONIC CONTROLS STUDY Summary Report
P. W. Vinson and R. D. Mc Donald Dec. 1963 23 p
(Contract DA-01-009-AMC-5(Z))
(OR-3719)

The experimental phase of the study consisted of a wind-tunnel evaluation of various control devices mounted near the base of a cone-ogive-cylinder model. Experimental data were obtained at Mach 5.98 and 10.2 and over a range of Reynolds numbers from 2.5×10^6 per foot to 25×10^6 per foot. Analytical studies were conducted to support theoretical analysis and correlation of experimental data. Author

N64-30829 Deutsche Versuchsanstalt für Luft- und Raum-Fahrt, Aachen (W. Germany) Inst. für Angevandte Gasdynamik
APPROXIMATION THEORY FOR THE AXISYMMETRIC SUBSONIC AND SUPERSONIC FLOW ON AND NEAR COMPOSITE MISSILES WITH FINITE CROSS SECTION AT TAIL [NAHERUNGSTHEORIE FUR DIE ACHSENSYMMETRISHE UNTER- UND UBERSCHALLSTROMUNG AN UND NAHE VON ZUSAMMENGESETZTEN FLUGKORPERN MIT ENDLICHEM HECKOUERSCHNITT]
Friedrich Keune Jul. 1964 115 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-10; DVL-303)

A special case of the extension of the familiar linear theory gives the effect of finite cross-sectional areas on the axisymmetric flow around the front of pointed bodies-of-revolution for a segmented rocket body. The flow in the region of the finite-end cross section of each segment is derived by exact mathematical transformations. Satisfying the boundary conditions of the mentioned body is considered to be iteratively possible only when the components of flow can be analyzed with even power series of small radial distances that are presumed small for the body length. The typical physical difference between cross-sectional flow and area effect is maintained in general, and leads to a particularly clear indication of the characteristic differences between subsonic and supersonic flows. A relaxation of the strict conditions of this theory leads to previous approximations for slender and not-so-slender bodies. The first two approximations of the distribution of source functions and of the velocity of both subsonic and supersonic flows are calculated for a half-body cylinder combination. Trans. by I.v.L.

N64-30893 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
AN ENGINEERING EVALUATION OF AIRPLANE GUST LOAD ANALYSIS METHODS. VOLUME I: THEORETICAL DEVELOPMENT
Dino George, John B. Smedfjeld, and George R. Schriro Oct. 1963 191 p refs
(Contract NOw-60-0449-c)
(ADR-06-14-63.1; AD-447413)

Airplane longitudinal motion is described by a linear, multi-degree-of-freedom system of forced response equations in terms of normal modes, where the basic inputs to the system are the generalized aerodynamic forces due to motion and gust. The modes considered in the analysis are two symmetric rigid-body modes (vertical translation and pitch) and an arbitrary number of symmetric vibration modes of the wing and fuselage with the stabilizer assumed rigid. In formulating the generalized forces, strip theory, appropriately modified to yield experimental complete-airplane steady-state stability derivatives, is used. The lifting elements (strips) of the airplane are an arbitrary number of wing and tail panels per side. Development of the generalized force variations is carried out through use of Duhamel's integral, with the unsteady aerodynamics due to motion, gust, and downwash being described by indicial lift functions, which include both compressibility and aspect ratio effects. Author

N64-30926 Ohio State U. Research Foundation, Columbus Aerodynamics Lab.
HYPERSONIC BLUNT BODY SIMILITUDE IN A PERFECT GAS
G. M. Gregorek and K. D. Korkan Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jun. 1964 37 p refs
(Contract AF 33(657)-10416)
(FDL-TDR-64-92; AD-605380)

The strong similitude of the hypersonic flow of a perfect fluid about blunt bodies is considered. Using a continuous flow wind tunnel, the pressure distribution, shock-wave shape, and shock detachment distances about spheres and cylinders are obtained at Mach numbers from 8 to 15 and at Reynolds numbers from 2,000 to 75,000. With the help of low Mach number data from the open literature, correlations of the observed quantities are formulated, demonstrating a near Mach number independence of the flow. A correlation of the sphere shock profile by the normal shock density ratio is of special interest. Author

N64-31141 Saarland U., Saarbrucken (W. Germany)
OSCILLATION IN AXIAL-FLOW COMPRESSORS Final Technical Report, 1 May 1962–31 May 1963
H. Söhngen, E. Meister, and H. Stolley 10 Mar. 1963 72 p ref
(Contract DA-91-591-EUC-2406)
(FTR-1/23; AD-421928)

The following papers are presented: (1) "The Unsteady Subsonic Flow Through an Oscillating Staggered Cascade of Infinite Chord Lengths"; (2) "An Investigation of the Feasibility of Mathematical Techniques for Evaluating the Aerodynamic Forces Acting on the Oscillating Blades of any Cascade with Finite Spacing and Chord"; (3) "The Effect of Finite Spacing on the Aerodynamic Forces Acting on the Oscillating Blades of a Vertical Cascade"; (4) "Aerodynamic Forces Acting on the Oscillating Blades of a Staggered Cascade of Line Profiles of Small Spacing"; (5) "A Feasible Explanation of the Rotating Stall." E.K.R.

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-30595 Naval Ordnance Lab., White Oak, Md.
STABILITY OF A TOWED OBJECT Mathematics Report M-52
Walter P. Reid Oct. 1964 28 p refs
(NOLTR-64-116; AD-447154)

The problem under consideration is that of a bilaterally symmetrical object being pulled along in air in a straight line at constant speed by a single towline, which is assumed to remain straight and to be of constant length. Linearized approximations to the differential equations of motion are developed. Two characteristic equations are obtained from these by postulating exponential solutions. A criterion for stability is that the roots of these equations have only negative real parts. Author

N64-30964 Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
EXTENSION OF THE DOUGLAS NEUMANN PROGRAM TO PROBLEMS OF LIFTING, INFINITE CASCADES
Joseph P. Giesing 2 Jul. 1964 73 p refs
(Contract Nonr-4308(00))
(LB-31653; AD-605207)

The two-dimensional Douglas Neumann program for calculating the potential flow about bodies of arbitrary shape has been extended to handle lifting, infinite cascades. Essentially, the program can handle any problem in which the flow pattern repeats indefinitely along an axis. In the Douglas Neumann program this axis is the y-axis. This permits the calculation of the flow about a lifting or nonlifting cascade having any stagger angle and spacing and having arbitrary blade geometry. The program can also calculate the flow about more than one cascade. Thus it can handle the interaction problem of two or more parallel cascades. The Douglas Cascade Program is compared with other theoretical methods, special analytical cases, and experimental data. Program details, among which are input–output format and FORTRAN listing, are given. Author

N64-31080* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECTIVENESS OF THREE EXIT VANE CASCADE CONFIGURATIONS FOR VECTORING THE THRUST OF A DUCTED FAN
Kenneth W. Mort and Paul F. Yaggy Washington, NASA, Oct. 1964 32 p refs
(NASA-TN-D-1688) OTS: $0.75

The thrust vectoring effectiveness was evaluated for three vane configurations by examining the aerodynamic characteristics obtained with vane deflection angles from 0° to 100°, fan advance ratios from 0 to just under 0.7, and at duct angles-of-attack from 0° to 90°. Analysis of the results indicated that it would be undesirable to use vanes of the type tested to produce large amounts of thrust vectoring because of the magnitude of the accompanying losses in performance. However, the vanes did have the capability of producing small amounts of thrust vectoring and large pitching-moment changes without significant losses in performance. Because of this, the vanes are potentially an efficient source of longitudinal trim and control for ducted fan powered vehicles. Author

N64-31128 General Electric Co., Cincinnati, Ohio Flight Propulsion Lab.
RESULTS OF STATIC TESTS OF A FULL SCALE, WING MOUNTED, TIP TURBINE DRIVEN LIFT FAN Technical Report, Dec. 1960–Apr. 1961
Ft. Eustis, Va., Army Transportation Res. Command, Mar. 1962 277 p refs
(Contract DA-44-177-TC-584)
(TCREC-TR-62-21; AD-285037)

This report covers 53 hours of testing propulsion system performance, effects of inlet configuration, and roll–yaw control capability are discussed. Author

N64-31221* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DATA ON LARGE SEMISPAN TILTING WING WITH 0.6-DIAMETER CHORD, SINGLE SLOTTED FLAP, AND SINGLE PROPELLER ROTATING UP AT TIP
Marvin P. Fink, Robert G. Mitchell, and Lucy C. White Washington, NASA, Oct. 1964 148 p refs
(NASA-TN-D-1586) OTS: $2.75

The wing had a ratio of chord to propeller diameter of 0.6, a single slotted flap, an aspect ratio of 4.05 (2.025 for the semispan), a taper ratio of 1.0, and an NACA 4415 airfoil section. The basic leading-edge configuration had practically no stall on that portion of the wing immersed in the propeller slipstream at angles well above those corresponding to the peak of the lift curve for the high thrust conditions corresponding to operation in the STOL range of flight; in general, the stall on the wing center section coincides with the angle-of-attack for maximum lift for the low thrust coefficients. Author

N64-31222* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL STABILITY CHARACTERISTICS OF LOW-ASPECT-RATIO WINGS HAVING VARIATIONS IN LEADING- AND TRAILING-EDGE CONTOURS
William P. Henderson Washington, NASA, Oct. 1964 45 p refs
(NASA-TN-D-1796) OTS: $1.25

The wings of this investigation employed flat-plate airfoil sections. Studies were conducted primarily at Mach 0.40; one of the wings was investigated at Mach 0.40 and 0.60. The angle-of-attack was varied from −5° to 22°. The test Reynolds number per foot varied from 2.52×10^6 at Mach 0.40 to 3.40×10^6 at Mach 0.60. The results of this investigation indicate that removing area from the trailing edge of the basic clipped delta wing results in decreases in the longitudinal stability at low lift coefficients, whereas removing area from the leading edge generally results in increases in the longitudinal stability at moderate lift coefficients. By applying the proper modification to both the leading and trailing edges of the basic clipped delta wing, the aspect ratio can be materially increased with only small losses in the longitudinal stability at moderate lift coefficients. Author

N64-31224* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF SKEWED WING-TIP CONTROLS ON A HIGHLY SWEPT ARROW WING AT MACH NUMBER 2.03
Emma Jean Landrum Washington, NASA, Oct. 1964 24 p refs
(NASA-TN-D-1867) OTS: $0.75

This investigation of the effects of skewed wing-tip controls on an arrow wing was conducted in the 4- by 4-ft supersonic pressure tunnel at a Mach number of 2.03 and at a Reynolds number of 4.3×10^6 based on the wing mean aerodynamic chord. Tests were conducted for control hinge-line angles from 30° to 90° through an angle-of-attack range of −7° to 8° and a control-deflection-angle range of 0° to −12°. Wing leading-edge sweep was 70° and aspect ratio was 2.24. Author

N64-31243 McGill U., Montreal (Canada) Mechanical Engineering Research Labs.
THE EFFECT OF JET ENTRAINMENT ON LOSS OF THRUST FOR A TWO-DIMENSIONAL SYMMETRICAL JET-FLAP AEROFOIL

I. Wygnanski Aug. 1964 46 p refs
(DRB G-9551-12)
(Rept.-64-13)

Jet drag, defined as the form drag associated with jet entrainment in otherwise inviscid fluid, has been analyzed by replacing a two-dimensional incompressible jet with a suitable continuous distribution of sinks. Exact solutions for the jet drag, with the flow incompressible and the jet turbulent, are presented for uncambered struts of various shapes (including an ellipse and a circular cylinder), various thickness ratios, and with blowing slots of various widths in both quiescent and uniform streaming flow. In the latter cases the jet is blowing in the direction of the external flow. The extension of the theory to cross-stream blowing (as in the jet flap) is discussed. The present theory compares favorably with the few available experimental results when the jet velocity to streaming-flow velocity is sufficiently large. Author

N64-31308 California Inst. of Tech., Pasadena Hydrodynamics Lab.
LINEARIZED THEORY OF A TWO-DIMENSIONAL PLANING FLAT PLATE IN A CHANNEL OF FINITE DEPTH-1
D. K. Ai, A. J. Acosta, and Z. L. Harrison Apr. 1964 47 p refs
(Contract Nonr-220(43))
(Rept.-110.2; AD-602201)

Linearized free-streamline theory is used to calculate the spray-sheet thickness and lift slope for a flat plate, cavitating, two-dimensional hydrofoil in a channel of finite depth with an upper free surface and lower boundary partly free and partly rigid. Only the case of zero cavitation number is considered. Some measurements were made of the submergence of a hydrofoil of four-inch chord beneath the undisturbed free surface at velocities of 12 and 18 fps. These agree with the trends of the theory but not with the magnitudes, the submergence always being greater than that predicted by the theory. Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-30228 Joint Publications Research Service, Washington, D.C.
THE INFLUENCE OF AN AUTOMATIC PILOT ON THE DYNAMICS AND SAFETY OF FLIGHT OF A FLEXIBLE AIRCRAFT IN A TURBULENT ATMOSPHERE
Yu. P. Dobrolenskiy *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 220–240 refs (See N64-30207 22-01) OTS: $6.00

The dynamics of an aircraft with a flexible wing in flight in a turbulent atmosphere is investigated. It is shown that the consideration of the deflection of the wing depending on its structure may lead both to a decrease and to an increase in the strain experienced by the aircraft. The influence of an automatic pilot on the statistical characteristics of extended motion and on the safety of flight in the range of vertical gusts of wind is clarified. Author

N64-30564 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MODERN MILITARY TRANSPORT PLANES
5 Nov. 1963 5 p Transl. into ENGLISH from Repules (Budapest), no. 6, 1963 p 16
(FTD-TT-63-790/1+2; AD-602604)

Brief descriptions are given of the Antonov-An-4 (and advanced versions An-8 and An-12) and of the Transall C-160 military transport planes. P.V.E.

N64-30675 Naval Civil Engineering Lab., Port Hueneme, Calif.
FRICTION COEFFICIENTS BETWEEN TIRES AND PAVEMENTS SURFACES
H. Tomita 15 Jun. 1964 74 p refs
(R-303; Y-F015-15-02-120; AD-602930) OTS: $2.00

A review of the problem of aircraft skidding on Naval airfields during landings and a thorough literature search on the work conducted on friction coefficient were made. It was found that low friction coefficients were responsible for some aircraft accidents on Naval airfields. Basic studies indicated that the actual friction coefficients between tires and pavement surfaces did not follow the basic laws of friction. The total frictional force included, in addition to the basic frictional force, a mechanical force resulting from the interlocking of the rubber with the aggregate particles protruding above the pavement surfaces. Author

N64-30728 North American Aviation, Inc., Los Angeles, Calif.
THE AEROMEDICAL ASPECTS OF THE XB-70 AIRCRAFT
Robert T. Donaldson *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 225–233 (See N64-30712 22-16)

In the XB-70 development the "shirt sleeve" environment is the approach that prompted vigorous research and development accomplishments. In regard to this approach, the emergency ram air or flood flow system is indicated as the initial protective system where decompression or cabin contamination becomes a significant hazard. The XB-70 escape capsule with its ejection capability is the last resort protection. Examples of its protective features are explained graphically by showing the "worst eventuality" situation. Some minor environmental conditions are briefly discussed also. Author

N64-30828 Bureau of Naval Weapons, Washington, D.C. Weapon Systems Analysis Div.
ESTIMATION OF STOL A/C TAKE-OFF DISTANCES
E. A. Thibault Aug. 1964 18 p refs
(R-5-64-17; AD-603375) OTS: $1.00

For the purposes of this present study, STOL aircraft were defined as those requiring a takeoff ground roll of less than 1,000 ft. Two existing takeoff ground-roll estimate methods were evaluated by comparing predicted values with available data for several STOL aircraft. The resulting accuracies were, respectively, within 9% and 11% error. It was found that one of these methods could be further simplified and yet still yield acceptable results; that is, excluding two predictions, this simplified method yielded an accuracy within 13% error. In addition, some correlation was found to exist between short takeoff ground roll and total distance over a 50-ft obstacle. As a result an expression was derived relating the two. Author

N64-30912 Chance Vought Corp., Dallas, Tex. Ltv Vought Aeronautics Div.
XC-142A VTOL TRANSPORT PROGRAM Monthly Progress Report No. 22
L. C. Josephs Oct. 1963 33 p
(Contract AF 33(657)-7868)

The #1 airplane midsection and nose section were joined, and fabrication of the first set of main and nose landing gear were completed. All flight-control-system design information tests on the various subsystem test fixtures were complete with completion of the aft section and main prop static test jig programs. Fabrication of the wing for the flight-control simulator was completed, and installation was accomplished. Author

N64-30913 Ling-Temco-Vought, Inc., Dallas, Tex. Aeronautics Div.
XC-142A VTOL TRANSPORT PROGRAM
L. C. Josephs Mar. 1964 36 p
(Contract AF 33(657)-7868)
(MPR-27)

Developments in the following parts of the program are summarized: (1) fabrication of five prototype models; (2) ground testing; (3) engineering data in support of manufacturing and test programs; (4) development of design data; and (5) flight test and demonstration. Shakedown of the flight-control-simulator installation was completed. Work on the static test program progressed with the operational tests on the aileron having been completed and operational tests of the flap system initiated. Tests to ultimate of the prop pitch cables and backup structure in the wing were completed, as were static tests of the rod ends for the engine struts. P.V.E.

N64-30995* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LARGE-SCALE WIND-TUNNEL TESTS OF DESCENT PERFORMANCE OF AN AIRPLANE MODEL WITH A TILT WING AND DIFFERENTIAL PROPELLER THRUST
Wallace H. Deckert, V. Robert Page, and Stanley D. Dickinson Washington, NASA, Oct. 1964 42 p refs
(NASA-TN-D-1857) OTS: $1.00

Tests were conducted to determine the wing stall, performance, and longitudinal stability and control characteristics of a large model of a V/STOL tilt-wing transport aircraft. The scope of the tests was limited primarily to the low-speed transitional regime. Test configurations included wing-tilt angles from 0° to 40°, double-slotted trailing-edge flaps deflected from 0° to 60°, various wing leading-edge devices, such as partial-span and full-span Krüger flaps and slats, and several ramps that extended from the top of the fuselage to the tilted-wing center section. Author

N64-31000* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF THE DYNAMIC STABILITY AND CONTROL CHARACTERISTICS FOR A TRANSPORT CRUISING AT A MACH NUMBER OF 3
Lawrence W. Brown Washington, NASA, Oct. 1964 36 p refs
(NASA-TN-D-2483) OTS: $1.00

A theoretical investigation has been made of the characteristic modes of the dynamic lateral stability of a supersonic-transport configuration, cruising at a Mach number of 3 at altitudes of 60,000 ft and 70,000 ft with trim angles-of-attack of 3.6° and 5.8°, respectively. The stability and flying qualities were studied by using the classical linearized equations of lateral motion, the ratio of the roll angle to the equivalent side velocity, and the ratio of the roll angle to sideslip. The effects of the cross-control derivatives on the stability of the configuration with damper augmentation were investigated. In addition, the roll coupling of the unaugmented configuration was considered. Results show that the interaction of the roll and yaw dampers and the change in stability with altitude require a system with variable damper gains to obtain satisfactory lateral stability. In addition, too small a value of the static directional derivative may cause large roll-to-sideslip ratios and roll-coupling problems. Author

N64-31081* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF GROSS CHANGES IN STATIC DIRECTIONAL STABILITY ON V/STOL HANDLING CHARACTERISTICS BASED ON A FLIGHT INVESTIGATION
John F. Garren, Jr., James R. Kelly, and John P. Reeder Washington, NASA, Oct. 1964 17 p refs
(NASA-TN-D-2477) OTS: $0.50

A flight investigation utilizing a variable-stability helicopter was conducted in order to determine the effects of gross changes in static directional stability on V/STOL handling qualities and on requirements for directional sensitivity and damping during low-speed operation. Tasks under both simulated instrument and visual conditions were for evaluation of the handling characteristics provided by various combinations of static directional stability, directional sensitivity and damping, and dihedral effect. The results indicate the increases in static directional stability, when accompanied by appropriate increases in directional damping, yield improved handling qualities. Minimum satisfactory levels of directional sensitivity and damping correspond to current criteria. Author

N64-31101 Federal Aviation Agency, Washington, D.C. Office of Supersonic Transport Development
SONIC BOOM EFFECTS ON LIGHT AIRCRAFT, HELICOPTERS, AND GROUND STRUCTURES Research Paper, 3 Feb.–10 Apr. 1964
Joseph Kenneth Power Jun. 1964 44 p refs Presented at the Am. Soc. for Testing and Mater., Chicago, 25 Jun. 1964
(AD-602175)

Light aircraft, helicopters, and their pilots were tested for responses to sonic boom both on the ground in a static condition and while flying at 5,000 feet. Conclusions reported for the aircraft structures and for the pilots are, in general, that sonic-boom effects are negligible. A series of tests were designed and executed over Oklahoma City to determine sonic-boom effects for the supersonic-transport-development program. Four houses were instrumented, and supersonic flights were carried out along a predetermined flight path. Early partial results are presented in terms of public reaction, damage suits, telephone calls, and test-house measurements. D.E.W.

N64-31110 Harry Diamond Labs., Washington, D.C.
OPTIMIZING A SETBACK LEAF SYSTEM FOR SAFETY
Arthur Hausner 12 Jun. 1964 32 p refs
(HDL-TR-1233; AD-445887)

A procedure for optimizing a setback leaf system for safety against a malfunctioning parachute is discussed. The principal feature is a computer search for parameters to maximize a function that is proportional to the minimum velocity change needed for arming. Items needed for the analysis include the firing acceleration and coefficient of friction. The latter is generally not constant and various functions must be tried in a given situation to insure that the design is not too sensitive

to fluctuations in friction. The procedure was applied to compute modifications of the M517 mechanism, to meet parachute-malfunction safety requirements without sacrificing reliability, but met with little success in that the modified models failed to arm over the temperature range. Author

N64-31174 Columbia U., New York, N.Y.
AN INVESTIGATION OF HIGH-ALTITUDE BALLOONS OF SHAPES WHICH ARE NOT ROTATIONALLY SYMMETRIC Final Report
H. H. Bleich May 1963 23 p
(Contract Nonr-266(87))
(AD-419722)

An attempt was made to explain the occurrence of nonsymmetrical balloon shapes, using the assumption that the balloon material is in a uniaxial state of stress in the direction of the meridians. The attempt was unsuccessful; the assumption does not permit the existence of nonsymmetric balloon shapes. The analysis indirectly proved that whenever nonrotationally symmetric balloon shapes occur, the state of stress in the fabric cannot be one dimensional, i.e., hoop and shear stresses must occur. R.L.K.

N64-31228 Raven Industries, Inc., Sioux Falls, S. Dak.
BALLOON OPERATIONS AT FT. CHURCHILL, 1963 Final Report
D. Johnson, Frank O. Heidelbauer, Charles H. Cravaack, and G. W. Fendrich 31 Oct. 1963 158 p
(Contract Nonr-3390(08))
(Rept.-1363; AD-421823)

The 27 balloon launchings that took place in 1963 are reported, and flight reports plus time–altitude curves and trajectory maps are presented. Launch and recovery techniques are described. R.L.K.

N64-31303 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
FLYING QUALITIES DEMONSTRATION AND SPIN EVALUATION OF EXTENDED WING MOHAWK
R. Tumilowicz 29 Jul. 1963 49 p refs
(Contract NOAS-59-8032-c)
(FT-134-0-Ia.8; AD-447960)

The extended-wing airplane exhibited similar flying qualities to that of the 42-ft-span airplane with some slight improvements and no major detrimental effects. High Mach number characteristics and dynamic lateral stability remain approximately the same as the short-wing aircraft. Directional control characteristics with asymmetric power have changed slightly under the influence of increased wing area, aileron area, and power from the L7 engine. No change in single-engine minimum control speed was found in the takeoff configuration, whereas a six-knot reduction was found in the clean configuration. Roll performance in the clean configuration is slightly improved over the short wing "B" at the demonstration speed of 0.8 V_H and stall characteristics are similar except for a tendency toward random lateral rolloff at stall. The spin evaluation was performed on a comparative basis with the short-wing airplane. Control for satisfactory spin recovery is the same as the short-wing requirement. Author

N64-31306 Bell Aerosystems Co., Buffalo, N.Y.
DEMONSTRATION PLANNING AND PROGRESS REPORT, MODEL X-22A
W. R. Denson 21 Jan. 1964 53 p
(Contract NOw-63-0118-C1)
(Rept.-2127-931001; AD-447814)

This report represents the latest planning for the demonstration of the two X-22A aircraft, as well as proof of design tests and submittal dates for contract design data. To keep submittal material up to date, additional and/or revised pages shall be included at intervals not exceeding 2 months. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-30455 Joint Publications Research Service, Washington, D.C.
RECENT DEVELOPMENTS IN LUNAR ASTRONOMY
18 Sep. 1964 31 p ref Transl. into ENGLISH of 2 articles from Priroda (Moscow), no. 6, Jun. 1964 p 44–55
(JPRS-26460; TT-64-41718) OTS: $2.00

CONTENTS:
1. LUNAR "GEOLOGY" V. V. Kozlov and Ye. D. Sulidikondrat'yev p 1–14 ref
2. WHAT WE CAN OBSERVE ON THE MOON K. A. Kulikov p 15–28 ref

N64-30502* Canterbury U., Christchurch (N. Zealand)
RADAR INVESTIGATION OF METEORS AT HIGH RATES OF DETECTION Final Report
C. Ellyett, C. S. L. Keay, and E. C. Mc Lauchlan Sep. 1963 44 p refs
(Grant NsG-219-62)
(NASA-CR-58685) OTS: $2.00 fs; $0.50 mf

The construction and operation of an improved type of radar system for delineating meteor radiants are discussed. High rates of detection, quite often exceeding 1,000 meteors per hour, have been obtained. It is found that the very faint meteors, which are detected in such large numbers, completely obliterate many of the recognized showers. Author

N64-30516* Boston U., Mass.
CATALOG OF LUNAR CRATERS
Gerald S. Hawkins, David D. Friesen, Peter W. Mitchell, Frank Hugh Byers, Badri Aghassi et al May 1964 109 p refs *Its* Astron. Contrib., Ser. II, v. 5, no. 36
(Grant NSG-246-62)
(NASA-CR-58785) OTS: $4.00 fs; $0.75 mf

Several well-defined areas on the lunar surface, representing both maria and highland regions, were selected, and all crater-like formations in these areas were measured and described according to numerical code. The highland region includes a section extending from the center of the lunar disk toward the limb on the southeast edge of the moon. The maria region includes Sinus Aestuum and parts of Mare Nubium. About 3.1% of the lunar surface lies within these boundaries. Measurements of 2659 crater formations are included. The information listed for each crater includes a sequence number, the crater name, the coordinates in the direction-cosine projection and in the latitude–longitude system, the diameter, a description of degree of definition and shape, special notes on physical structure, and a notation of the photograph (from the "Photographic Lunar Atlas," edited by G. P. Kuiper) on which the measurements were taken. There is also a section

on coordinate transformation, a photographic finding list, an alternate reference list to trace craters to references in the literature, and an alphabetical list of named craters. R.L.K.

N64-30663 Lincoln Lab., Mass. Inst. of Tech., Lexington
HAYSTACK POINTING SYSTEM: SUN Group Report 1964–40
H. E. Frachtman 29 Jul. 1964 35 p
(Contract AF 19(628)-500)
(ESD-TDR-64-355; AD-603318) OTS: $3.00

SUNTRACK is a program in the Haystack Univac 490 pointing system whose output is the celestial coordinates of the sun at a given time. The program computes the coordinates by 3rd difference interpolation in the tables of the apparent right ascension, declination, and radius vector of the sun published in The American Ephemeris. The rates of change of the three quantities are computed by numerical differentiation. Author

N64-30688 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COMPOSITION, STRUCTURE, AND CONDITIONS OF CRYSTALLIZATION OF IRON METEORITES
A. A. Yavnel' 28 Jul. 1964 22 p refs Transl. into ENGLISH from Meteoritika (Moscow), no. 22, 1962 p 83–93
(FTD-MT-64-283; AD-603398) OTS: $1.00

A correlation of various studies on the composition, structure, and conditions of crystallization of iron meteorites indicates the following conclusions: (1) The phase composition of iron meteorites can be explained by phase diagrams of the complex Fe-Ni-Co-P-S system. (2) The composition and relationship of phases in meteoritic iron, to a first approximation, can be explained by phase diagrams of the Fe-Ni system. (3) Ambiguous connections between the structure and composition of iron meteorites (nickel content) indicate the differences in the conditions of their crystallization. ,4) Experimental data on the nonuniform composition of the separate phases of meteoritic iron (taenite, kamacite, schreibersite, rhabdite, and troilite) suggest the absence of equilibrium conditions during its crystallization, both at comparatively low temperatures and at high temperatures. P.V.E.

N64-30836* Consultants and Designers, Inc., Arlington, Va.
NARROW PASS BAND – PHOTOELECTRIC SPECTROMETRY OF STARS OF FIRST SPECTRAL TYPES [SPECTROMETRIE PHOTOELECTRIQUE A BANDE PASSANTE ETROITE DES ETOILES DES PREMIERS TYPES SPECTRAUX]
Daniel Barbier and Nina Morguleff 11 Aug. 1964 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. Astrophys. (Paris), v. 258, Group 3, no. 20, 20 May 1964 p 4925–4927
(Contract NAS5-3760)
(NASA-TT-F-8942; ST-SA-10188) OTS: $1.00 fs; $0.50 mf

An instrument for narrow-pass-band photoelectric spectrometry is described. It consists of a spectrograph having two fused silica prisms whose slit is replaced by a circular hole. In the focal plane, the selector device successively isolates several spectral bands. This device allows the execution of several research programs concerning different problems. The condensing lens resets the different radiations on the sensitive layer to 20 stages of the Lallemand electron amplifier. The recorder is triggered by means of an amplifier described by P. Maines. The first series of measurements were made from October 12 to October 24, 1963. It inaugurated a classification program of stars of the spectral-anterior type to class F_5. The program of measurements was established to permit the determination of physical specific quantities—the gradients in the red and blue, the magnitude of the Balmer discontinuity, and line intensities. I.v.L.

N64-30837* Consultants and Designers, Inc., Arlington, Va.
ON PERTURBATIONS OF HYPERBOLIC ELEMENTS [O VOSMUSHCHENIYAKH GIPERBOLICHESKIKH ELEMENTOV]
Kh. Kh. Akhmad 14 Aug. 1964 19 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz. Astron. (Moscow), no. 3, 1964 p 15–27
(Contract NAS5-3760)
(NASA-TT-F-8943; ST-CM-10190) OTS: $1.00 fs; $0.50 mf

This report is devoted to the construction of an analytical theory of hyperbolic-element perturbations. To that effect, the Lagrange differential equations for osculating hyperbolic elements are derived. For the analytical integration of these equations, which include the partial derivatives of the perturbation function by elements, it is necessary to expand the elements. This expansion is most simply obtained for the case of a circular restricted three-body problem. At the same time, the expansion of the perturbation function must be obtained for two variants: the intrinsic variant where $r < a_j$, and the extreme variant where $r > a_j$. Here r is the radius vector of a body moving relative to a central body (S) along a hyperbola, and a_j is the distance from S to a body moving along a circle relative to S. The final expression for the expansions of the perturbation function in the case of a hyperbolic motion of the intrinsic variant and of the extreme variant is obtained by powers of semiaxes ratios. I.v.L.

N64-30841* Consultants and Designers, Inc., Arlington, Va.
EFFECT OF PHOTODISSOCIATION ON THE DISTRIBUTION OF SURFACE BRIGHTNESS IN THE CARBON ATMOSPHERE OF COMETS [O VLIYANII FOTODISSOTSIATSII NA RASPREDELENIYE POVERKHNOSTNOY YARKOSTI V UGLERODNOY ATMOSFERE KOMET]
D. O. Mokhnach 21 Aug. 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (Moscow), v. 157, no. 2, 1964 p 309–312
(Contract NAS5-3760)
(NASA-TT-F-8948; ST-OA-10195) OTS: $1.00 fs, $0.50 mf

A simple model of a carbon coma is constructed in order to explain the observed departures from the law 1/R in various cometary observations. A formula is deduced for the visible density, taking into account the dissociation of glowing molecules. Observations of the distribution of surface brightness in the head of the comet 1959k show that Miller's assumption that the cause of deflection from the law 1/R is photodissociation is plausible. M.P.G.

N64-30845* Consultants and Designers, Inc., Arlington, Va.
METHODS OF OBSERVATION OF THE SOLAR CORONA DURING NON-ECLIPSE TIME [LES METHODES D'OBSERVATION DE LA COURONNE SOLAIRE EN DEHORS DES ECLIPSES]
J. C. Perche 31 Aug. 1964 11 p Transl. into ENGLISH from L'Astronomie (Paris), Jun. 1964 p 219–227
(NASA-TT-F-8952; ST-SP-10199) OTS: $1.00 fs; $0.50 mf

This report emphasizes the direct measurements of the intensity of the coronal lines (E corona), by means of the Lyot coronometer, and the observation of the white corona and associated instrumentation. I.v.L.

N64-30855* Consultants and Designers, Inc., Arlington, Va.
POLARIZATION EFFECT ON RADIO SIGNALS SCATTERED BY METEOR TRAILS [VLIYANIYE POLYARIZATSIONNOGO EFFEKTA NA RADIOSIGNALY, RASSEIVAYEMYYE METEORNYMI SLEDAMI]

M. F. Lagutin and B. L. Kashcheyev 24 Sep. 1964 5 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 8, 1964 p 1494–1495
(Contract NAS5-3760)
(NASA-TT-F-8962; ST-IM-10211) OTS $1.00 fs; $0.50 mf

Two independent and identical transmitting devices, working in the same frequency of 39 Mc/sec, were used for a study of polarization phenomena. Measurements were conducted mainly in the northerly direction during daytime hours when the probability of occurrence of resonance effect was greatest. It was found that the manifestation of polarization effect took place for ~50% of the signals. A decrease of diffraction-pattern fluctuations is noted for reflections of various polarizations. A.W.

N64-31008* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
ESCAPE OF STARS DURING THE COLLISION OF TWO GALAXIES
George Contopoulos and George Bozis (Yale U. Obs.) Repr. from Astrophys. J., v. 139, no. 4, 15 May 1964 p 1239–1250
(NASA-RP-325)

An approximate theory is developed to find out whether a star, moving initially on the plane of symmetry of a galaxy, escapes during the collision with another galaxy of small dimensions. The escaping stars are inside an ellipse on the plane of symmetry of the galaxy. Numerical calculations in a Bottlinger model of a galaxy give results of the same order of magnitude. The total amount of the escaping matter is only a few percent of the total mass of the galaxy, if the collision velocity is of the order of 2000 km/sec. The behavior of the escaping and nonescaping stars is described. The escaping stars do not follow the colliding galaxy and do not form a bridge or link between the two galaxies. Author

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-30448 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
POWER CONVERSION IN SPACE
I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. 3: Theoret. [1964] 25 p refs Presented at the I.E.E. Colloq. on Elec. Methods of Propulsion in Space, London, 13 Feb. 1964 (See N64-30440 22-24) OTS: $6.00

For power levels up to about 100 kwe, solar- or isotope-powered systems will probably provide the necessary power for space vehicles; power levels of about 50 kwe will enable early interplanetary missions to be accomplished using electric propulsion systems. For power levels ranging from 50 kwe to several tens of Mwe, several alternative conversion systems based on nuclear reactors are under consideration. Of these, alkali metal Rankine cycle turboelectric systems are receiving the most attention at present, although many problems beset the development program. Several other systems, based on the Brayton gas cycles, show promise of greater efficiencies and reliabilities, thermionic and MPD systems being particularly interesting above 1 Mw. It is possible that the ultimate choice of system will be based on reliability (particularly for manned mission), and the use of hybrid systems involving two, or more, of the conversion methods mentioned above, should not be discounted. Author

N64-30449 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
A NON-EQUILIBRIUM ELECTRON MODE FOR KILOWATT-RANGE MPD SPACE POWER
I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res. Programme. Part 3: Theoret. [1964] 16 p refs Presented at the 6th AGARD Combust. and Propulsion Colloq. Cannes, Mar. 1964 (See N64-30440 22-24) OTS: $6.00

Nonequilibrium flow is proposed as a solution to the problem of increasing the electrical conductivity of a closed-cycle nuclear magnetoplasmadynamic generator without increasing the gas temperature. Theoretical examination of the nonequilibrium expansion, through a hyperbolic nozzle, of a plasma with small fractional seeding shows that the nozzle-exit conductivity will be higher than the equilibrium value. If such a nozzle immediately precedes a MPD-generator section, this high conductivity permits high-power outputs to be achieved with relatively small devices. The optimum throat area for a helium–1-at.% cesium plasma at a nozzle-inlet stagnation temperature of 2,000° K will be about 1.5 cm^2. It is concluded that the nonequilibrium mode of producing extrathermal ionization in the MPD-generator channel is of interest for space power sources and should be investigated further. In addition, nonequilibrium flow can be used in conjunction with other methods of producing extrathermal ionization. M.P.G.

N64-30521* Pennsylvania U., Philadelphia Towne School of Civil and Mechanical Engineering
[RESEARCH IN THE CONVERSION OF VARIOUS FORMS OF ENERGY BY UNCONVENTIONAL TECHNIQUES] Status Report, Jun. 1964
J. O'm Bockris 10 Aug. 1964 29 p
(Grant NsG-316)
(NASA-CR-58809) OTS: $2.00 fs; $0.50 mf

Three areas of research are discussed: (1) studies related to biochemical fuel cells; (2) plasma physics; and (3) thermal-energy storage. This is the current status, in the same sequential order: (1) Pyruvate, under conditions close to physiological (0.1 M phosphate buffer pH = 7.4), was converted almost quantitatively into lactate, at the cathodically charged working electrode by the catalyst lactic dehydrogenase. The results of coulombic yield studies for the oxidation of diphosphopyridine nucleotide dehydrogenase (DPNH) and for the reduction of diphosphopyridine nucleotide (DPN)—one of the cofactors required for the activity of dehydrogenase enzymes—revealed that neither was DPNH produced cathodically from DPN nor was DPN produced anodically from DPNH. (2) A model analogous to the one used for a semiconductor sandwiched between two metals was used to study the effects of electrode spacing and sheath thickness on the electron and ion currents. The refined macroscopic phenomenological model of a broad-spaced plasma diode was used in the determination of criteria for specifying the emitter-sign sheath. (3) Experiments have been conducted to establish the phase diagram of $MgF_2 + MgO$ by differential thermal analysis. I.v.L.

N64-30527 Consolidated Controls Corp., Bethel, Conn.
EMITTER-COLLECTOR PAIRS FOR GAS PLASMA THERMIONIC ENERGY CONVERSION Final Technical Report, Dec. 1962–Dec. 1963
R. Engdahl [1963] 66 p
(Contract Nonr-4023(00))
(HD-6827; AD-601256)

These are the results of the study: (1) Twelve different rare-earth emitters were evaluated for zero-field vacuum-emission characteristics. (2) Using W and Gd_2O_3 as prime constituents, four different emitter-fabrication methods were evaluated. (3) Zero-field pulse emission from Gd_2O_3 in a tungsten helix was measured at 9.6 amps/cm^2 at 1,450° C. (4) Zero-field pulse emission from a sintered W-10% Gd_2O_3-0.25% $BaCO_3$ was measured at 3.34 amps/cm^2 at 1,500° C. (5) A collector work function of 1.0 ev was attained by a nickel collector coated with 200 A of Al_2O_3 and evaporated barium. (6) A collector work function of 0.9 ev was attained by a nickel collector coated cataphoretically with 20 microns of Gd_2O_3 and evaporated barium. (7) A method for measuring collector work functions by means of electron absorption was developed and proven. (8) Three different auxiliary discharge mechanisms were evaluated; one showed decided superiority in regard to efficiency. Author

N64-30539 General Dynamics/Fort Worth, Tex.
[SNAP-10A AND SNAP-2/AGENA-D MODEL ENVIRONMENT EVALUATION AND PARAMETERS] Quarterly Progress Report, 1 Jan.–31 Mar. 1964
R. O. Furlow 10 Apr. 1964 2 p
(Contract AF 29(601)-5852)
(QPR-3; AD-442856)

For the SNAP-10A system, the neutron flux level varied as much as a factor of 50 between the vehicle axis and vehicle skin, and the gamma dose varied no more than a factor of 1.1. For the SNAP-2 system, the neutron fluxes and gamma dose rates were found to have little variation between the vehicle axis and vehicle skin. At positions on the vehicle axis near the mating plane of each system, the integrated neutron flux and gamma dose for a year's time were calculated to be 3.6 × 10^{12} n/cm^2 and 5.5 × 10^8 ergs/gm(c) for the SNAP-2 system and 6.8 × 10^{12} n/cm^2 and 6.3 × 10^8 ergs/gm(c) for the SNAP-10A system. The power levels are 55 kw(th) for SNAP-2 and 33 kw(th) for SNAP-10A. Author

N64-30557 General Motors Corp., Indianapolis, Ind. Allison Div.
ANALYSIS OF SOLAR REFLECTORS. MATHEMATICAL THEORY AND METHODOLOGY FOR SIMULATION OF REAL REFLECTORS Final Report
G. L. Schrenk and D. G. Gritton 16 Dec. 1963 129 p refs
(Contract AF 04(695)-335)
(EDR-3693; AD-602870)

A mathematical model for analysis of actual solar reflectors is formulated. This model makes it possible to calculate the energy flux on any arbitrarily shaped focal surface from any arbitrarily shaped reflector surface. Provisions are included for treating random surface errors on the reflector surface, orientation errors of any size, and vignetting of reflected radiation by a cavity opening. No approximations have been introduced into this model. Operative computer programs for evaluating solar reflectors have been developed from these equations. Details concerning these programs are presented. Author

N64-30603* Telecomputing Corp., Denver, Colo.
SILVER–CADMIUM BATTERY DEVELOPMENT PROGRAM
James M. Rice Washington, NASA, Sep. 1964 222 p refs
(Contract NAS5-1431)
(NASA-CR-85) OTS: $3.50

The development of a lightweight, silver–cadmium secondary battery for space applications is described. The original concept for the battery incorporated the use of unit cells, with units connected in series to provide sufficient voltage, and cells connected in parallel to provide sufficient capacity. The electrodes were to be of the duplex type, and the battery case was to be filament wound, for light weight, utilizing the circular cells as a mandrel. A change in the concept was required during the program. The cells were encased in plastic cell containers, and the duplex electrode concept could not be realized. The filament-wound case was maintained. Author

N64-30605* Monsanto Research Corp., Everett, Mass. Boston Lab.
STUDY OF FUEL CELLS USING STORABLE ROCKET PROPELLANTS Quarterly Report No. 2, 28 Apr.–27 Jul. 1964
J. C. Orth, R. E. Chute, R. Havlin, K. W. Klunder, S. Matsuda et al 25 Sep. 1964 99 p refs
(Contract NAS3-4175)
(NASA-CR-54170; MRB-5007Q2) OTS: $3.00 fs; $0.50 mf

Developmental work on a fuel cell operating on storable reactants, and design progress on a fuel cell that will operate relatively efficiently on a variety of fuels and oxidants are reported in the following areas: (1) porous teflon vapor-diffusion-electrode development; (2) evaluation of fuel cells with ion-exchange membranes; (3) construction of a monomethylhydrazine reformer; and (4) palladium–hydrogen diffusion-electrode testing. M.P.G.

N64-30659* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECTS OF IMPURITIES ON RADIATION DAMAGE OF SILICON SOLAR CELLS
Joseph Mandelkorn, Lawrence Schwartz, Jacob Broder, Harold Kautz, and Robert Ulman Repr. from J. of Appl. Phys., v. 35, no. 7, Jul. 1964 p 2258–2260 refs
(NASA-RP-314)

A theory was formulated to explain the effects of impurities in silicon solar cells on radiation damages. A relation between the element used as an acceptor or donor in the base region of solar cells and the diffusion length preserved in the base region after bombardment has been shown to exist. Since the simple recombination theory does not take into account the role of acceptors or donors as participants in the formation of recombination centers, it cannot be expected that the results of the experiments conform with the recombination theory. The effects of impurities on the original characteristics of silicon material and devices are often obscured by uncontrolled variables in growth and processing. IAA

N64-30701 Pratt and Whitney Aircraft, East Hartford, Conn.
LIQUID METAL-HEATED SPACE RADIATOR-MOUNTED THERMIONIC GENERATOR First Quarterly Report, 1 Jul.–30 Sep. 1963
F. C. Harter [1963] 57 p
(Contract AF 33(657)-11320)
(PWA-2275; AD-422200)

Work was initiated to evaluate a thermionic converter suitable for liquid metal heating in space radiator configurations. The converter incorporates a tantalum–10% tungsten alloy liquid-metal containment tube insulated by BeO from a tungsten–25% rhenium emitter. A nickel collector with an interelectrode space of 8 mils has been selected. The predicted performance of this converter indicates a power output of 4.7 w/cm^2 with an efficiency of 12% when the emitter temperature is 1,500° C. A bifilar tungsten filament was selected for use as a heater. Author

N64-30749 Air Force Special Weapons Center, Kirtland AFB, N. Mex. Research and Technology Div.
MILITARY NUCLEAR POWER PLANTS

John D. Belson Jun. 1964 213 p refs
(WL-TDR-64-25; AD-602678)

This report was designed primarily to assist both Air Force planning groups and civil engineering functions in the proper adaptation of nuclear power to satisfy their requirements. Air Force, Army, and AEC interrelationships within the nuclear power program are discussed, along with development and procurement procedures. Selection standards and training requirements for nuclear powerplant operators and officers-in-charge are presented. Cost curves have been included to aid in estimating the capital and operating costs of nuclear and conventional powerplants and the break-even fuel-oil prices for nuclear versus fossil-fuel plants. The capabilities of nuclear power within existing technology are evaluated, and possible areas of application discussed. Author

N64-30863* Mallory (P.R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science

RESEARCH AND DEVELOPMENT OF A HIGH CAPACITY NONAQUEOUS SECONDARY BATTERY Fourth Quarterly Report

[1963] 32 p refs
(Contract NAS3-2780)
(NASA-CR-54164) OTS: $2.00 fs; $0.50 mf

The principal concern has been to establish more clearly the relationship between known variations in electrolyte composition and observed changes in electrode behavior. Emphasis has been given to studying the effects resulting from the deliberate addition of water to various propylene carbonate solutions. The role water may play as a deleterious and difficultly removable impurity and as an excellent Lewis base by which the electrolyte composition may be modified was studied. Author

N64-30878 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THREE-PHASE SYNCHRONOUS GENERATOR

L. M. Palastin 9 Jul. 1964 5 p Transl. into ENGLISH from Russian Patent no. 153324 (Appl. no. 730172/24-7), 12 May 1964 p 1–3
(FTD-TT-64-486/1+2; AD-603399) OTS: $1.00

A three-phase synchronous generator without brush contact is proposed. Three stator packets are arranged in series along a shaft having a concentrated armature winding and an excitation winding. The packets are spaced on the shaft 120° apart in order to provide flux switchover. The proposed generator is unique in that its excitation winding is common to all three stator packets, thus economizing on copper and reducing the weight and dimensions of the generator. M.P.G.

N64-30900 General Motors Corp., Anderson, Ind. Delco-Remy Div.

FEASIBILITY STUDIES OF THE ELECTROTHERMALLY REGENERATIVE TRANSDUCER Final Report

Robert D. Weaver 30 Mar. 1963 152 p refs
(Contract DA-33-008-ORD-2335)
(AD-403290)

A new method of converting thermal energy to electricity has been investigated and the results are presented. The method employs electrochemical principles, and the device has been named the Electrothermally Regenerative Transducer. The study has shown a limiting efficiency of 35% conversion of heat. A transducer system capable of providing 500 A continuously at 28 V, with a maximum current of 5000 A at 18 V, has been designed. The average efficiency calculated for the design is 24% and the weight is 811 lb. Laboratory data obtained on single electrodes show current densities of more than 25 $A/in.^2$ to be possible. Author

N64-30921 Air Force Systems Command, Wright-Patterson AFB, Ohio Aero Propulsion Lab.

THERMAL VACUUM TEST OF ORBITAL STATIC MOISTURE-REMOVAL FUEL CELL Technical Documentary Report, Mar. 16–20, 1964

L. S. Harootyan, Jr. Jul. 1964 21 p refs
(APL-TDR-64-72; AD-605310)

This report presents the results of a thermal vacuum chamber test of an orbital fuel cell of advanced design. The fuel cell package used a static moisture-removal system. The fuel cell gave satisfactory results. The nominal voltage–ampere and power–ampere curves are summarized. The shroud temperature was varied between −45° and +210° F during the 98 hours of testing; this range well exceeded the specified temperature range. The successful startup and 98 hours of continuous operation (only 50 hours were required for qualification) at its rated nominal output of 44 watts in a thermal vacuum chamber resulted in final ground qualification of the fuel cell package. Author

N64-30972 General Instrument Corp., Newark, N.J. Thermoelectric Div.

SOLAR FLAT PLATE THERMOELECTRIC GENERATOR RESEARCH

Robert E. Rush Wright-Patterson AFB, Ohio, Aero Propulsion Lab., 14 Sep. 1964 75 p refs
(Contract AF 33(657)-10335)
(APL-TDR-64-87; AD-605931)

A solar flat plate thermoelectric converter consists of a collector plate with an optically selective coating, small size thermoelements, a radiator plate, and a support structure. The collector and radiator plates were folded into self-supporting structures that, combined with aluminum tubular members, comprised the panel-support configuration. This design resulted in a very low converter weight, only 53 g/ft^2. A number of prototype panels, both 4 × 4 in. and 12 × 12 in. in area were fabricated and tested. Evaluation of the optically selective coating disclosed that the coating efficiency actually obtained in the pilot production runs was only 80% of the literature value. The processing of the bismuth telluride thermoelectric material into the shape and size required for the solar panels caused a decrease in performance relative to large-size thermoelements. The overall panel performance in the Earth orbit operational temperature regime resulted in approximately 11 W/lb of panel. Author

N64-31009* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

RESULTS OF STUDIES ON A TWIN-GYRO ATTITUDE-CONTROL SYSTEM FOR SPACE VEHICLES

Armando E. Lopez, Jack W. Ratcliff, and Jerry R. Havill Repr. from J. Spacecraft and Rockets, v. 1, no. 4, Jul.–Aug. 1964 p 399–402 ref Presented at AIAA Guidance and Control Conf., Cambridge, Mass. 12–14 Aug. 1963
(NASA-RP-328; AIAA Paper-63-332) AIAA: $0.50 members; $1.00 nonmembers

A brief review is given of an investigation on the attitude stabilization of a large space vehicle using twin gyros as torque sources. Two control systems were investigated—an automatic closed-loop system and a pilot-operated system. The automatic system was capable of maintaining attitude stabilization to within 1 sec of arc; the pilot-operated system was capable of attitude stabilization to 5 sec of arc. The estimated weight of a twin-gyro control system is compared with that of a reaction control system as a function of the length of time these perform similar attitude-stabilization tasks. IAA

N64-31017 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
AUXILIARY POWER GENERATING SYSTEM FOR A MANNED SPACE LABORATORY Douglas Engineering Paper No. 1409
A. Duane Tonelli [1963] 21 p refs Presented to ASME, Los Angeles, 6 Mar. 1963
(ASME Paper-63-AHGT-71)

Presented is the design evaluation for the selection of the auxiliary power generating system of a two-man 60-day-mission space laboratory. Principle factors used for the selection of the auxiliary power systems were weight, mission time, and availability. Deployment area was also considered for solar power systems. Author

N64-31167 General Motors Corp., Indianapolis, Ind. Allison Div.
ANALYSIS OF SOLAR REFLECTORS MATHEMATICAL THEORY AND METHODOLOGY FOR ERROR MODEL SYNTHESIS FROM EXPERIMENTAL RAY TRACE DATA Final Report
1 Sep. 1964 137 p refs
(EDR-3958)

Mathematical techniques for the analysis of experimental ray-trace (Hartman) data are formulated. Using these techniques, the coordinates of the reflector surface and the direction cosines of the actual surface normals can be calculated from various types of ray-trace data. Errors can then be calculated by comparing these results to those of a perfect reflector. Once errors are calculated, they can then be analyzed statistically. No numerical approximations have been introduced into these analytical techniques. Operative computer programs for analyzing optical ray-trace data have been developed from these equations. Details concerning these programs are presented. Author

N64-31198 Martin Co., Baltimore, Md. Nuclear Div.
A STUDY PROGRAM ON CESIUM VAPOR-FILLED THERMIONIC CONVERTERS HAVING HIGH VACUUM WORK FUNCTION EMITTER MATERIALS Yearly Summary Report, 1 Nov. 1962–31 Oct. 1963
D. S. Trimmer, A. J. Kennedy, and M. E. Talaat 31 Oct. 1963 127 p refs
(Contract Nonr-3639(00))
(MND-3100; AD-422395)

An extensive mapping of the performance of cesium vapor-filled thermionic energy conversion devices was obtained for the high-vacuum work function emitter materials iridium and rhenium. Characteristic current versus voltage curves and summaries of the output power density are given for the emitter temperature range of 1,600° to 2,100° K, the liquid cesium temperature range of 450° to 675° K, the collector temperature range of 555° to 1,075° and for interelectrode spacing from 0.004 in. to 0.052 in. The devices used in this program were of flat-plate geometry and were so designed that the interelectrode spacing could be varied accurately and continuously under the conditions that the other test parameters were maintained constant. Consequently, the dependence of performance on interelectrode spacing could be measured to high precision. Author

N64-31252 General Electric Co., Auburn, N.Y.
RESEARCH ON THIN FILM POLYCRYSTALLINE SOLAR CELLS Quarterly Technical Progress Report, 1 Jul.–30 Sep. 1963
R. W. Aldrich et al Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab. [1963] 37 p
(Contract AF 33(657)-10601)
(QTPR-4; AD-421700)

The emphasis of the thin film solar cell work was on the following: (1) growing acceptable cadmium telluride films in vertical substrates to yield more usable area; (2) fabricating cells that have junction areas of 40 to 50 cm^2; (3) experimenting with different surface treatments to yield more uniform cells; (4) investigating methods of attaching leads to the cells (indium soldering seems satisfactory); (5) taking data on 4-month old cells to see how the cell parameter changes with time; and (6) performing basic studies of the properties of junctions between CdTe and other materials. Author

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-30313 Chicago U., Ill. Lab. of Molecular Structure and Spectra
THE INTERACTION OF ELECTRON DONORS AND ACCEPTORS
Robert S. Mulliken *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 117–147 refs (See N64-30304 22-23)
(NSF G-20375)

This paper reviews some aspects of the theory of the interaction of electron donors and acceptors, with particular reference to 1:1 interactions in solution. The classification of donors and acceptors, and the characteristics of various types of donor-acceptor interaction pairs (ion-pairs, H-bonded complexes, 2-way charge-transfer complexes, reaction intermediates, contact pairs, intramolecular π island interactions, etc.) are discussed, including halogen complexes of *n* donors and of π donors. It is shown that the *n* donor complexes conform well to predictions of the general theory, and that some account must be taken of the participation of more than one dative resonance structure in stabilizing the normal state of most complexes. Also discussed are the structure and charge-transfer spectra of complexes of the classical benzene–iodine type, as well as the interaction of neutral-molecule even-electron donors and acceptors. Author

N64-30376 Atomic Energy of Canada, Ltd., Chalk River, Ontario Chalk River Nuclear Labs.
RECENT APPLICATIONS OF TRACERS IN THE PHYSICAL SCIENCES
R. H. Betts and J. A. Davies [1964] 12 p refs Presented at the 3d Intern. Conf., Geneva, 31 Aug.–9 Sep. 1964
(AECL-2003)

The work reviewed in this paper represents a cross section of a much larger body of research published in Canada since the last Geneva Conference. To give focus, the review deals mainly with the physics and chemistry of solids and interfaces. Many of the examples chosen illustrate the power and uniqueness of tracer methods in elucidation of complex physicochemical phenomena. Author

N64-30462 Lund U. (Sweden) Thermochemistry Lab.
THERMOCHEMISTRY LABORATORY REPORT, 1 JANUARY 1963 TO 1 JANUARY 1964
15 Mar. 1964 13 p refs Sponsored by AF; Army; Swedish Tech. Res. Council et al

This report is concerned with thermodynamic fundamental data and with the importance of media effects in bioenergetics. The heat of formation of H_2SO_4 was derived as -213.91 ± 0.17 kcal/mole^{-1} and that of HBr was -29.00 kcal/mole^{-1}. An example of the importance of media effects is given by the hydrolysis reaction of a simple model peptide: $BuNHCOMe + H_2O \rightarrow BuNH_2 + MeCOOH$. For the reaction in dilute H_2O (hypothetical process, no ionization of the reaction products), the heat of hydrolysis is $\Delta H = +10.8$ kcal/mole^{-1}, whereas the gas phase heat of reaction (ideal gas state) is $+5.8$ kcal/mole^{-1}. This illustrates that the change in solvation enthalpy is of the same order of magnitude, and therefore, is equally as important as the enthalpy changes associated with the dissociation and re-formation of chemical bonds, changes in resonance energies, and steric effects. I.v.L.

N64-30494 Peninsular ChemResearch, Inc., Gainesville, Fla. Research Div.
SYNTHESIS AND POLYMERIZATION OF FLUORINATED SULFUR MODIFIED NITROSO RUBBER Quarterly Report, 1 Jul.–30 Sep. 1963
Eugene C. Stump and Calvin D. Padgett 21 Oct. 1963 33 p refs
(Contract DA-19-129-AMC-152(N))
(QR-1; AD-437996)

The synthesis of CF_3SNO, SF_5NO, and C_6F_5SNO has been investigated. Initial attempts to prepare these compounds were unsuccessful. The precursor to $CF_3SCF{=}CF_2$ has been prepared by the ultraviolet catalyzed addition of trifluoromethanesulfenyl chloride to chlorotrifluoroethylene. Thiocarbonyl fluoride was prepared but did not copolymerize with CF_3NO under the conditions employed. A mixture of $F_2C{=}S$, CF_3NO, and $CF_2{=}CF_2$ gave a copolymer of CF_3NO and $CF_2{=}CF_2$. Pentafluoronitrosobenzene was prepared and found to copolymerize readily with $CF_2{=}CF_2$ and $CF_2{=}CFCl$. A terpolymer with CF_3NO and $CF_2{=}CF_2$ was also prepared. Author

N64-30515* National Bureau of Standards, Washington, D.C.
A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Progress Report for Period Ending 31 Jul. 1964
George T. Armstrong, George T. Furukawa, and Joseph Hilsenrath 1 Aug. 1964 57 p refs
(NASA Order R-138)
(NASA-CR-58786; NBS-8521) OTS: $3.00 fs; $0.50 mf

Heat capacities of compounds of hydrogen, carbon, nitrogen, oxygen, phosphorus, and sulfur are presented in tabular form, along with relative enthalpies and entropies. A preliminary compilation of data on heats and free energies of reaction and formation is also given. A.W.

N64-30531 Western Reserve U., Cleveland, Ohio John Schoff Millis Science Center
KINETIC STUDIES OF THE HYDROGEN ELECTRODE WITH THE ROTATING DISK TECHNIQUE
M. P. Makowski, Ewald Heitz, and Ernest Yeager 15 Jul. 1964 130 p refs
(Contract Nonr-2391(00))
(TR-19; AD-604268)

The present work was undertaken to elucidate some aspects of the anodic oxidation of hydrogen on a rotating platinum disk electrode under conditions that allowed polarization studies at atmospheric and elevated pressures up to 60 atm. Solutions of 1 N HBr, H_2SO_4, and $HClO_4$ were used. All anodic polarization curves showed characteristic current density maxima or flat portions. The position of the maxima with respect to the overpotential coordinate was found to depend on the pretreatment of the electrode, on the potentiostatic scan rate, and to some extent on the angular velocity of the disk. Under comparable conditions the maxima occurred at about the same overpotentials when the pressure was varied up to 600 atm. The data in all experiments with 1 N HBr and in most tests with 1 N H_2SO_4 showed upon treatment by the rotating disk–reaction order method that the anodic hydrogen reaction on platinum in these media is first order with respect to concentration of hydrogen. No kinetic control could be ascertained in 1 N $HClO_4$ in the range investigated, since the process showed exclusive diffusion dependence. Cathodic measurements yielded 0.03 Tafel slopes at various rotation rates and pressures in all three electrolytes. Author

N64-30535 United States Rubber Co., Wayne, N.J. Research Center
PHOSPHONITRILIC POLYMERS STABLE AT HIGH TEMPERATURES Quarterly Report, May 1–Jul. 31, 1964
Harold K. Garner, Gearld J. Klender, and Aspet Merijanian 24 Aug. 1964 39 p refs
(Contract NObs-90089)
(QR-3; AD-604733)

The objective of this investigation is the development of new thermoplastic and thermosetting resins from phosphonitrilic chloride trimer for high-temperature electrical applications. Improved methods for introducing phenoxy blocking groups into the trimer were developed. Additional work was done on the amino derivatives. Copolymerization of phosphonitriles of reduced functionality with hydroquinone was studied, and the introduction of the isocyanate function into the trimer was accomplished. Author

N64-30550 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
GAS-SOLID INTERACTIONS AT ELECTRODE SURFACES Technical Summary Report, Apr. 1–Sep. 30, 1963
H. Saltsburg and D. P. Snowden 20 Nov. 1963 28 p refs
(Contract DA-44-009-ENG-4832; ARPA Order 223-61)
(GA-4719; AD-424656)

Frequency-dependent electrical conductivity has been studied in powders of NiO and NiO doped with Cr^{3+} ions. The form of the dispersion of the conductivity for pure NiO implies that the gross geometrical nature of the solid is not reflected by these measurements, as has been commonly assumed. When Cr^{3+} ions are incorporated into the NiO lattice, a different dispersion is observed, which is interpretable as resulting from a nonuniform distribution of Cr^{3+} in the solid. In order to be able to relate conductivity changes to carrier concentration, the mobility of the charge carriers in NiO has been measured in a microwave Faraday rotation experiment. At 350° C, $\mu \leq 0.8$ cm^2/v-sec. A mechanism has been proposed to quantitatively describe the nonexponential kinetics of the O_2-induced conductivity decay on NiO whose surface O_2 concentration has been reduced by pulsed reaction with H_2. The mechanism involves the multiple trapping of the ion generated by adsorption followed by an eventual stabilization of a neutral species that remains on the surface. Author

N64-30560 Peninsular ChemResearch, Inc., Gainesville, Fla.
SYNTHESIS AND POLYMERIZATION OF FLUORINATED SULFUR MODIFIED NITROSO RUBBER Quarterly Report, 1 Oct.–31 Dec. 1963
Eugene C. Stump and Calvin D. Padgett 21 Jan. 1964 30 p refs
(Contract DA-19-129-AMC-152(N))
(QR-2; AD-602885)

Efforts to prepare CF_3SNO and SF_5NO have continued. The new monomer $CF_3SCF{=}CF_2$ was prepared and its reactivity with CF_3NO and $CF_2{=}CF_2$ was examined. An attempt to homopolymerize $CF_3SCF{=}CF_2$ using cobalt-60 irradiation gave a very low conversion. Ultraviolet irradiation of mixture of $CF_3SCF{=}CF_2$ and CINO in the gas phase gives a blue liquid, probably either $CF_3SCFCICF_2NO$ or $CF_3SCF(NO)CF_2Cl$. Attempts to obtain copolymers from both thiocarbonyl fluoride and perfluorothioacetone were not successful. The intermediate CF_3SCl was prepared by an alternate synthesis involving the gas-phase irradiation of a mixture of CF_3SSCF_3 and chlorine. Author

N64-30582 Midwest Research Inst., Kansas City, Mo.
SYNTHESIS OF ELASTOMERS CONTAINING Si-N BONDS IN THE MAIN CHAIN Quarterly Progress Report, 1 Apr.–30 Jun. 1964
L. W. Breed and R. L. Elliott 15 Jul. 1964 21 p refs
(Contract DA-23-072-ORD-1687)
(QPR-9; AD-602453)

Rubbery products have been obtained when silazane–organic diol polymers are heated with compounds containing the cyclotriphosphazatriene ring, but it has not been established that the polymers are crosslinked by these reagents. Two new polymers were prepared from cyclotrisilazanes containing ethyl and benzyl groups. Although both polymers had good hydrolytic stability, thermal stability was poor. A detailed examination of the thermal and oxidative stability showed that a nonamethylcyclotrisilazane-bisphenol "A" polymer was thermally stable at 300° C, but underwent oxidative degradation at that temperature. Author

N64-30583 Temple U., Philadelphia, Pa. Research Inst.
PRODUCTION, ISOLATION AND IDENTIFICATION OF THE OF, O_2F AND O_3F RADICALS Quarterly Progress Report, 1 Apr.–30 Jun. 1964
A. D. Kirshenbaum and A. V. Grosse [1964] 17 p refs
(Contract AF 04(611)-9555)
(QPR-3; AD-603226)

The EPR spectrum of O_2BF_4 at 77° K consists of a single asymmetric broad line signal with a peak-to-peak separation of 335 gauss and an average g value of 1.94. The O_2F_2 in $CCIF_3$ warmed to 145° K and then recooled at 77° K produced a new EPR signal. This signal was superimposed on the original O_2F signal but not at the expense of the O_2F. The O_4F_2 is 100% paramagnetic. At 77° K, O_4F_2 in CF_4 is in a semifrozen state, i.e., semitumbling state. The O_4F_2 signal is different from that obtained for O_2F_2 and O_3F_2 and is therefore not due to O_2F. The OF_2 is not paramagnetic, although a weak EPR signal is obtained that may be due to impurities. Author

N64-30586 Army Chemical Center, Edgewood, Md. Nuclear Defense Lab.
RADIOCHEMISTRY OF PLUTONIUM AND URANIUM IN SOIL
Ralph F. Benck, Robert J. Smith, John Bogdan, Henry Lada, and Henry Mortko Jun. 1964 23 p refs
(NDL-SF-7; AD-446343)

Methods for the analyses of trace (microgram) quantities of plutonium and uranium by ion-exchange separation from fission products and soil constituents are presented. The plutonium is measured, either by alpha counting electroplated stainless-steel disks with a thin window counter, or by liquid scintillation counting of the elutant from the ion-exchange step. The quantities of uranium are determined fluorometrically. Author

N64-30624 Calvin Coll., Grand Rapids, Mich.
THE DECOMPOSITION OF SILVER OXIDE IN ALKALINE SOLUTIONS
Thedford P. Dirkse, David Vander Hart, and Jack Vriesenga 1 Jul. 1964 19 p refs
(Contract Nonr-1682(02))
(TR-2; AD-603306)

The decomposition of silver (I) oxide in aqueous potassium hydroxide has been studied using titrimetric, radioactive tracer, and gas evolution techniques. The rate of decomposition is dependent on temperature, photo effects, and the presence of foreign materials. Author

N64-30625 Mound Lab., Miamisburg, Ohio
SHOCK TUBES: A BIBLIOGRAPHY
Arnold M. Melnick 11 Sep. 1964 56 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1189) OTS: $1.25

N64-30635 Atomics International, Canoga Park, Calif.
CHROMATOGRAPHIC ANALYSIS OF GASES OVER LIQUID SODIUM
Donald L. Johnson 15 Sep. 1964 34 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8448) OTS: $0.75

A gas chromatograph was incorporated into a recirculating loop in which helium was pumped from a Na-filled capsule to the chromatograph. The helium was analyzed for fixed gas content, and then returned to the capsule. Analysis of He, bubbled through carbon-saturated Na, revealed the gaseous impurities H_2 (1.0 vol.%), CH_4 (0.03 vol.%), and N_2 (1.0 vol.%). These gases appeared in lower concentrations over low-carbon Na. Neither CO nor CO_2 were detected at temperatures up to 1,200° F. The presence of H_2 and CH_4 indicates that one of the mechanisms of carburization is related to H_2, and is a function of the ratio $P_{CH_4}/P^3_{H_2}$, the activity of sodium hydride (NaH), and the equilibrium constants for the following reactions: $C + 2H_2 \rightleftarrows CH_4$ and $Na + 1/2\ H_2 \rightleftarrows NaH$. Author

N64-30664 Oak Ridge National Lab., Tenn.
[ACTIVITIES OF THE CHEMISTRY DIVISION] Annual Progress Report for Period Ending Jun. 20, 1964
E. H. Taylor, M. A. Bredig, and B. H. Ketelle Sep. 1964 153 p refs
(Contract W-7405-ENG-26)
(ORNL-3679) OTS: $2.75

Many brief reports are presented of research in the following areas: "Nuclear Chemistry"; "Nuclear and Inorganic Chemistry of Special Elements"; "Isotope Chemistry"; "Radiation Chemistry"; "Inorganic Chemistry"; "Chemistry of Aqueous Systems"; "Electrochemical Kinetics and its Application to Corrosion"; "Nonaqueous Systems at High Temperatures"; "Chemical Physics"; and "Water Research Program." E.K.R.

N64-30665 Wien U. (Austria) Federal Experimental and Research Inst.
ADVANCED STUDIES ON SINGLE BINARY AND TERNARY SYSTEMS OF OXIDES WITH HALOGENIDES (FLUORIDES, CHLORIDES, ETC.), SULFATES, CARBONATES, [AND] NITRATES IN RESPECT TO THE FORMATION OF REFRACTORY COMPOUNDS AND VOLATILE PHASES AND TO THE APPLICATION IN SPECTROCHEMICAL DISTILLATION-METHODS Final Technical Report, 1 Feb. 1962–31 May 1964
Erich Schroll [1964] 90 p refs
(Contract DA-91-591-EUC-2830)
(FTR-1964; AD-602819) OTS: $5.00

Reactions between oxides and halides, oxides and carbonates, and oxides and sulfates were studied. Reactions between oxides and nitrates were excluded because they react too violently. The reaction products were identified with the aid of X-ray diffraction. The patterns of more than 25 unknown, or supposed, compounds were recorded. Results of these studies showed the importance of the thermochemical reactions in the arc technique of spectrochemistry. Five main types of reactions could be pointed out—oxidation (volatile oxides), reduction (volatile elements), sulfurization (volatile sulfides), and halogenation (volatile halogen compounds). It was found that the reactions could be predicted by thermodynamical calculations. I.v.L.

N64-30667 Iowa State U. of Science and Tech., Ames Ames Lab.
CALCULATION OF ACID DISSOCIATION CONSTANTS
Wayne Woodson Dunning and Don S. Martin Feb. 1964 74 p refs
(Contract W-7405-ENG-82)
(IS-822) OTS: $1.75

A computational method has been developed for the determination of dissociation constants of acids (and bases). The method is applicable to monobasic or polybasic acids and, in certain cases, to mixtures of acids. A least-squares treatment is employed, and no simplifying assumptions are made in any of the equations or factors involved. All the available data are utilized, and provision is made for including or calculating activity coefficients. Utilization of the method requires a medium to large-size digital computer. Author

N64-30679 Bureau of Mines, Bartlesville, Okla. Petroleum Research Center
THERMOCHEMISTRY OF BORON AND SOME OF ITS COMPOUNDS. THE HEATS OF FORMATION OF TRIMETHYLAMINEBORANE AND ORTHOBORIC ACID
W. D. Good, M. Mansson, (Lund U.), and J. P. Mc Cullough [1963] 15 p Presented at the Symp. on Thermodynam. and Thermochem., Lund, Sweden, Jul. 1963
(Contract CSO-59-9; ARPA Order 24-59)
(AD-402335)

A rotating-bomb calorimetric technique was developed to solve the problem of determining the heats of combustion of organic boron compounds. The heats of combustion of crystalline boron and trimethylamineborane, $(CH_3)_3NBH_3$, were determined. The combustion product was a solution of fluoboric acid in excess aqueous HF. The standard heat of formation, $\Delta Hf°_{298.15}$, of trimethylamineborane (c,III) is -34.04 ± 0.55 kcal mole^{-1}. The heat of solution of orthoboric acid in an HF solution chosen to yield the same fluoboric acid solution was determined. The heat of formation of orthoboric acid was calculated; $\Delta Hf°_{298.15}(H_3BO_3,c) = -261.47 \pm 0.20$ kcal mole^{-1}. Combining these results with data from the literature permitted calculation of the heats of formation of B_2O_3 and B_2H_6 referred directly to crystalline boron. Author

N64-30681 Naval Research Lab., Washington, D.C. Chemistry Div.
THE CONDUCTANCE OF ALKALI-METAL SULFONATES IN POLAR ORGANIC SOLVENTS
R. C. Little and C. R. Singleterry 9 Jul. 1964 10p refs
(NRL-6116; AD-603243) OTS: $1.00

The conductance of lithium and cesium dinonylnaphthalene sulfonates has been measured in a variety of solvents at 35° C. Linear Shedlovsky plots indicating a simple ion/ion-pair equilibrium were obtained for the following systems: LiDNNS-methanol, LiDNNS-ethanol, LiDNNS-n-butanol, and CsDNNS-acetone. Comparisons of dissociation constants from these plots with published data for the corresponding halides show an increased tendency toward association for the sulfonates, the dissociation constants being smaller by an order of magnitude than for the halide salts. Association beyond ion-pairs was indicated by the nonlinear Shedlovsky plots observed for the following systems: CsDNNS-ethanol, CsDNNS-n-butanol, CsDNNS-methylisobutyl ketone, CsDNNS-nitromethane, CsDNNS-1-nitropropane, LiDNNS-nitroethane, LiDNNS-1-nitropropane, LiDNNS-acetone, and LiDNNS-methylisobutyl ketone. Author

N64-30689 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ANALYSIS OF HIGH-MELTING COMPOUNDS
G. V. Samsonovym, A. T. Pilipenko et al 17 Jun. 1964 330 p refs Transl. into ENGLISH of the book "Analiz Tugoplavkikh Soyedineniy" Moscow, Gos. Nauchn. Tekhn. Izd. Lit. Po Chernoy i Tsvetn. Met., 1962 p 7–256
(FTD-TT-63-814/1+2; AD-603009) OTS: $7.00

The discussion of the analysis of high-melting compounds is divided into the following areas: (1) general knowledge concerning high-melting compounds; (2) chemical properties of high-melting compounds; (3) methods of determining the basic components of high-melting compounds; and (4) analysis of high-melting compounds. P.V.E.

N64-30737 Illinois U., Urbana
SPIN-ECHO NMR STUDIES OF CHEMICAL EXCHANGE. I: SOME GENERAL ASPECTS
Adam Allerhand and H. S. Gutowsky 29 Apr. 1964 39 p refs Submitted for Publication
(Contract Nonr-1834(13)
(TR-71; AD-30737) OTS: $2.00

A method is described for calculating the chemical-exchange rate from the dependence of the apparent decay constant (T_2) upon the RF pulse separation (t_{cp}). This method has several advantages over the high-resolution NMR methods; one advantage is that larger values of exchange rate (shorter lifetimes) can be determined accurately. However, the spin-echo method does have the serious drawback that it lacks "resolution." The method was applied to the hindered internal rotation of N,N-dimethyltrichloroacetamide and dimethylcarbamyl chloride as a function of temperature. The resultant activation energies of 14.6 and 14.0 kcal/mole and the frequency factors of 3.5×10^{12} and 7.1×10^{10}, respectively, are appreciably higher than previously reported values. It is indicated that systematic errors are present. A simple arrangement is presented for generating the required Carr–Purcell pulse sequence with three waveform generators and two pulse generators. In addition, a described computer program was designed to determine the statistical errors in the values of $1/2\ \tau$, $\delta\omega$, and $T_2°$ derived from the spin-echo observations of T_2 vs t_{cp}. Here τ is the lifetime between exchanges; $\delta\omega$ is the chemical shift between the sites; and $T_2°$ is the transverse relaxation time "in the absence of exchange." I.v.L.

N64-30743 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro
MOLECULAR STRUCTURE INVESTIGATIONS WITH THE MOSSBAUER EFFECT
J. Danon 1963 10 p refs Presented at the III Intern. Conf. on Mössbauer Effect, Cornell U., N.Y., Sep. 1963 Submitted for Publication *Its* Notas de Fisica, Vol. X, No. 19

The following studies of molecular structure using the Mössbauer effect are reported: (1) nuclear isomer shift and nephelauxetic effect in iron complexes; (2) electronic structure

of Fe-NO complexes; and (3) Mössbauer effect with trivalent iron halides in different molecular symmetries. M.P.G.

N64-30750 Brookhaven National Lab., Upton, N.Y.
MANUAL OF ISOTOPE PRODUCTION PROCESSES IN USE AT BROOKHAVEN NATIONAL LABORATORY
Louis G. Stang, Jr. Aug. 1964 74 p refs Sponsored by AEC
(BNL-864(T-347)) OTS: $1.75

The isotopes covered are those requiring chemical processing after they are formed by irradiation. Techniques are described for producing aluminum 28, argon 38, copper 67, fluorine 18, gallium 68, iodine 124, iodine 132, iodine 133, magnesium 28, molybdenum 99, potassium 43, scandium 48, strontium 87m, technetium 99m, tellurium 132, xenon 128, and yttrium 90. A brief description is given of the facilities and specialized equipment of the Hot Laboratory Division, Nuclear Engineering Dept. R.L.K.

N64-30756 Dow Chemical Co., Denver, Colo. Rocky Flats Div.
THE SPECTROGRAPHIC DETERMINATION OF CESIUM IN PLUTONIUM METAL
E. Vejvoda 16 Sep. 1964 11 p ref
(Contract AT(29-1)-1106)
(RFP-420) OTS: $0.50

The metal sample is dissolved in hydrochloric acid to give a plutonium concentration of 20 g/l. A 25μ volume of the sample solution is pipetted onto a 800μg of sodium fluoride, which had been previously evaporated in a shallow electrode crater. Using an Ebert spectrograph, the cesium impurity spectrum is recorded on an IN photographic plate and the concentration determined photometrically using an analytical curve. Rubidium is employed as an internal standard. The line pair of Cs 8521.10A/Rb 7800.23A is applicable over a concentration range of 5 to 500 ppm cesium, while the line pair of Cs 8943.50A/Rb 7800.23A is used over a 500 to 10,000 ppm range. Author

N64-30766 General Dynamics/Astronautics, San Diego, Calif. Space Sciences Lab.
A REVIEW OF THE OXIDATION OF CARBON MONOXIDE AND RELATED REACTIONS
B. F. Myers and K. G. P. Sulzmann Jun. 1964 50 p refs (Contract DA-04-495-ORD-3383(Z); ARPA Order 393; Proj. Defender)
(GDA-DBE-64-001; AD-443789)

A literature review on the oxidation of carbon monoxide in systems principally containing carbon, oxygen, and inert constituents has been made. A useful result of the report experiments is obtained from various spectroscopic measurements, which show that the emission from a reacting system containing carbon monoxide and oxygen can be used to quantitatively measure the product of the atomic oxygen–carbon monoxide concentrations under a wide variety of experimental conditions; furthermore, there is, at present, some evidence indicating that the total emission in the CO-flame band region originates from bound states of the emitter in contrast to the usual assumption of the presence of an underlying continuum emission in this region. Of great significance to both the spectroscopic and kinetic aspects of the oxidation of carbon monoxide is knowledge about electronically excited states of carbon dioxide. Author

N64-30781 Rochester U., N.Y.
[HYDROGEN BONDING, OXIDATION KINETICS, AND SYNTHESIS OF THIOL AND AMINOTHIOL COMPOUNDS] Final Report, Oct. 1, 1959–Aug. 31, 1963
D. S. Tarbell 15 Mar. 1964 5 p refs
(Contract DA-49-193-MD-2031)
(AD-603220) OTS: $1.00

Work has been directed toward the following: (1) the study of hydrogen bonding in thiols and aminothiols; (2) the synthesis of compounds of the type R_2N-C-C-C-SH; and (3) the study of the kinetics of oxidation by air of aminothiols, as affected by pH, the presence of heavy metal ions, and the presence of chelating agents. Author

N64-30783* California U., Berkeley Lawrence Radiation Lab.
ON THE SPATIAL DISTRIBUTION OF RADICALS PRODUCED BY IRRADIATION
S. J. Wyard *In its* Suppl. to Biol. and Med. Semiann. Rept., Spring 1964 [1964] 7 p refs Presented at the 12th Ann. Meeting of the Radiation Res. Soc., Miami Beach, May 1964 Partially Sponsored by NASA (See N64-30782 22-16) OTS: $1.25

The use of electron-spin-resonance techniques to measure the spatial distribution of radicals in frozen solutions of hydrogen peroxide is presented. Two methods are briefly discussed; the first depends on the linewidth of the normal ESR spectrum at g = 2, whereas the second depends on the intensity of a "forbidden" transition that occurs at g = 4. If the radicals are distributed throughout the sample in pairs, clusters, or columns, the methods give the average spacing between radicals within individual pairs, clusters, or columns. The methods have been used to study the spatial distribution of radicals when they are produced by either uv or ionizing radiation. With uv radiation, the radicals are produced in pairs. The average separation varies, according to the conditions of radiation, from about 5 to 10 Å. Using ionizing radiation, the local concentration is close to the limit that can be measured, and is estimated at 0.05 mole, with the corresponding average separation being 32 Å. P.V.E.

N64-30784* California U., Berkeley Lawrence Radiation Lab.
EPR STUDIES ON OH RADICAL IDENTIFICATION IN IRRADIATED H_2O
T. E. Günter and C. D. Jeffries *In its* Suppl. to Biol. and Med. Semiann. Rept., Spring 1964 [1964] 6 p refs Partially Sponsored by NASA (See N64-30782 22-16) OTS: $1.25

Different spectra are usually found for polycrystalline ice irradiated and studied at 77° K and for ice irradiated and studied at 4.2° K. In the discussion presented, it is shown that the form of the spectrum of irradiated ice goes reversibly (without change) between the previously published 4.2° K and 77° K spectral forms. From this, it is considered likely that the spectra are caused by the same type of radicals. The reason for the spectral change does not appear to be a simple phase change, for both spectra showed hexagonal symmetry, as expected from tetrahedrally bonded ice. Also, the spectra of crystals that had been irradiated at 77° K, cooled to 4.2° K, and later heated again to 77° K were of the single-crystal type, rather than the polycrystalline type. As well as could be determined, these spectra were identical to those of the same crystal taken after irradiation at 77° K, but prior to cooling to 4.2° K. P.V.E.

N64-30789 Bureau of Mines, Albany, Ore. Metallurgy Research Center

A PROCESS FOR THE PREPARATION OF THORIUM BY SODIUM REDUCTION OF THORIUM TETRACHLORIDE

H. O. Poppleton and F. E. Block 1964 25 p refs
(BM-RI-6527)

This investigation was made to develop a method of preparing high-purity thorium metal in quantities up to 20 kg per batch. Several methods for the preparation, purification, and reduction of thorium tetrachloride are discussed. Thorium tetrachloride was prepared by chlorination of decomposed thorium nitrate or oxalate with carbon tetrachloride or phosgene. Purification of the crude tetrachloride was achieved by multiple distillations or by filtration of the molten chloride. It was found that high-purity thorium metal could be prepared by sodium reduction of thorium tetrachloride if chloride of sufficient purity were available. Byproduct salts and excess reductant were removed by vacuum distillation, and the resultant thorium metal sponge was consolidated by consumable-electrode or fixed-electrode arc melting. It was demonstrated that metal prepared by this method could be fabricated into bar, rod, or sheet, at room temperature. Author

N64-30790 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

ORGANIC CONSTITUENTS OF THE CARBONACEOUS CHONDRITES

Michael H. Briggs and Gregg Mamikunian Repr. from Space Sci. Rev. (Dordrecht), v. 1, 1962–1963 p 647–682 refs
(Contract NAS7-100)

From a brief discussion of forms of meteorite carbon it is concluded that almost all the carbon in the carbonaceous chondrites is present as organic matter. Attempts to extract and identify this organic matter are then reviewed. It is shown that only 25% has been extracted and only about 5% chemically characterized. Of this 5% most is a complex mixture of hydroxylated aromatic acids together with various hydrocarbons of the paraffin, naphthene, and aromatic series. Small amounts of amino acids, sugars, and fatty acids also are present. The possible chemical nature of the major fraction is discussed. It is suggested to be a mixture of high-molecular-weight aromatic and hydrocarbon polymers. Possible sources of contamination of the meteorites are described, and evidence indicating a general lack of organic contaminants is presented. It is concluded that most of the organic constituents are indigenous to the meteorites and are extraterrestrial in origin.
Author

N64-30800 Stanford Research Inst., Menlo Park, Calif.

VAPOR-PHASE REACTIONS OF ORGANIC COMPOUNDS WITH OXYGEN Annual Report, Jun. 21, 1963–Jun. 20, 1964

Frank R. Mayo and Theodore Mill 15 Jul. 1964 22 p refs
(Contract DA-18-108-AMC-202(A))
(AD-603096) OTS: $1.00

A series of gas-phase, peroxide-initiated oxidations of isobutane was carried out at 100° with pressures of isobutane ranging from 1 to 13 atm. The yields of hydroperoxide increased with increasing pressure, from 16% at one atmosphere to 92% at 13 atm (with < 1% conversion of isobutane). A large increase in surface area did not affect the rate of oxidation or the yield of hydroperoxide. Liquid-phase data on the oxidations of isobutane at 50° and 80° have been used to estimate rates of oxidation, kinetic chain lengths, and times for 99% conversion for oxidations of liquid isobutane and very dilute gaseous isobutane at 30°. The gas-phase oxidation of cyclopentene at 1 to 3 atm at 100° and 155° gave hydroperoxide (and its decomposition products), epoxide, and unidentified high-boiling materials in proportions that depend on the concentration of cyclopentene. The liquid-phase oxidation at 100° (and below) gave more than 90% yield of hydroperoxide. Author

N64-30819 Lexington Labs., Inc., Cambridge, Mass.

FEASIBILITY OF FORMING REFRACTORY FIBERS BY A CONTINUOUS PROCESS Fourth Quarterly Progress Report, 25 Nov. 1963–25 Apr. 1964

William B. Campbell [1964] 17 p
(Contract DA-19-020-AMC-0068(X))
(AMRA-CR-63-0314; AD-603455)

A technique for the continuous formation of refractory fibers and whiskers has been developed. The vapor phase process based on aluminum halide oxidation has been shown to be feasible for both batch and continuous whisker production. Substrate powders carried in the gas stream serve as nucleation sites for whisker growth. Aluminum oxide, silicon dioxide, and silicon nitride whiskers have been grown under the controlled conditions of the process. Author

N64-30825 Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.

UNSTEADY MASS TRANSFER WITH CHEMICAL REACTION. PART II: MORE GENERAL INITIAL AND BOUNDARY CONDITIONS Technical Note No. 89

Yih-Ho Pao Jul. 1964 14 p refs
(DI-82-0365)

In a steadily flowing or stationary medium, the concentration fields of the reactants and the products of all types of first-order reactions with equal diffusivities are related to that of a nonreacting species for certain nonuniform initial conditions and nonsimilar boundary conditions. Author

N64-30880 Naval Radiological Defense Lab., San Francisco, Calif.

SOLUTE DISTRIBUTION IN THE Na_2O-B_2O_3-NaCl SYSTEM. II: ALKALINE EARTHS AND RARE EARTHS

M. H. Rowell 17 Jun. 1964 27 p refs
(Contract AT(49-2)-1167)
(USNRDL-TR-760; AD-603382) OTS: $2.00

Radioactive tracers were used to determine the distribution of microquantities of Ba, Sr, Nd, and Eu between the two conjugate liquid phases throughout the immiscibility region in the system Na_2O-B_2O_3-NaCl at 830° C. Phase diagram data and borate–salt distribution coefficients of the solutes were obtained. The distribution coefficients of these cations increase according to their field strengths, in agreement with the previously proposed ion-exchange mechanism for solute distribution. Distribution coefficients are extremely sensitive to phase compositions, and increase with increasing Na_2O content, until maxima are reached in the region where the borate network structure begins to break down. Large separation factors exist between the alkali-metal, alkaline-earth, and rare-earth groups. Appreciable intragroup separation factors are also found, the Ba-Sr and Eu-Nd separation factors being about 2.7 and 1.9, respectively. Phase diagram and solute distribution data are correlated with known polyborate structures. Author

N64-30884 Florence U., (Italy)

RESEARCH ON THE INFLUENCE OF THE NATURE OF THE LIGAND ON THE STEREOCHEMISTRY OF THE NICKEL (II) AND OTHER 1ST ROW TRANSITION METAL COMPLEXES WITH SCHIFF BASES Final Technical Report, 1 Jun. 1963–1 May 1964

Luigi Sacconi [1964] 32 p refs
(Contract DA-91-591-EUC-2965)
(FTR-1; AD-602990)

The bis-(N-alkylsalicylaldimino)-nickel(II) complexes in the solid state and in solution may have a diamagnetic planar structure or paramagnetic polymeric or tetrahedral structures. The latter represents the first examples discovered of inner complexes of nickel(II) with a tetrahedral configuration. With a view to studying the factors that determine the stereochemistry in a given compound, particularly the tetrahedral configuration, the bis-(N-alkylsalicylaldimino)-nickel(II) complexes are examined. Author

N64-30916 Technische Hochschule in Wien (Austria)
POLAROGRAPHIC STUDIES IN CERTAIN NON-AQUEOUS SYSTEMS Second Annual Report
Victor Gutmann 3 Jan. 1963 54 p refs
(Contract AF 61(052)-487)

Experimental results show that aluminum and beryllium can be determined analytically in dimethyl sulfoxide by polarography. Results also indicate that nitrate ions, sulfur dioxide, hydrogen chloride, carbon dioxide, hydrogen sulfide, and several acid chlorides give polarographic waves in dimethyl sulfoxide that may be found useful in analytical determinations. Polarography in phenylphosphonic dichloride can be used under certain conditions to determine small amounts of water, or alcohols, or other compounds with active hydrogen, as well as to determine small amounts of one light active element in the presence of large excesses of a normally interfering similar element. D.E.W.

N64-30931 Mellon Inst., Pittsburgh, Pa.
FAR INFRARED TORSIONAL AND BENDING VIBRATIONS OF TOLUENE AND ITS DERIVATIVES AND THE BARRIER HEIGHT TO INTERNAL ROTATION Technical Documentary Report, Jun. 1963–Jun. 1964
William G. Fateley, Foil A. Miller, and Robert E. Witkowski Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 150 p refs
(Contract AF 33(657)-11142)
(ML-TDR-64-158, Pt. 1; AD-605410)

The far infrared spectra of ortho-, meta-, and parahalogenated toluene; and butadiene- and glyoxal-type molecules were investigated. Torsional vibrations were assigned, and barriers to internal rotation for methyl groups and C—C single bonds in conjugated systems were calculated. Low bending frequencies in aromatic and acyclic conjugated molecules were observed and in some cases assigned to specific vibrational motion. Results are given on the shift in frequency resulting from changes from liquid to vapor phase. Band contours in the midinfrared region for aromatic compounds have been studied in an attempt to distinguish molecules with free rotation of the methyl group. A performance comparison of Golay detectors to thermocouple is also reported. Author

N64-30966 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
PHYSICAL BASIS OF SEPARATING HELIUM AND NITROGEN
R. M. Ruemann and A. Fedoritenko 27 Jul. 1964 17 p refs
Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 7, no. 4, 1937 p 335–342
(RSIC-226; AD-603976)

Determinations are given for diagrams of p–x mixtures of helium–nitrogen under pressure of 5 to 150 atm and at temperatures of 64°, 78°, 90°, and 108° K and diagrams of T-x at 4 and 20 atm. Calculations are given for i-x-diagrams for pressures of 4 and 20 atm on the basis of T-x-diagrams. The purpose of this study was to solve the problem of obtaining pure helium from natural gases with the least possible loss of helium. Since all admixtures with the exception of N_2 were easily removed from natural gases, a binary admixture, $H_e - N_2$, was dealt with mainly. In order to select the means of obtaining helium of sufficient purity and reducing its losses to a minimum, it was necessary to study the equilibrium curves of this mixture when the method of deep cooling was used. Author

N64-30980 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
THE CHEMICAL KINETICS OF SODIUM IN RE-ENTRY
M. H. Bortner Apr. 1964 99 p refs
(Contract AF 04(694)-486)
(R64SD33; AD-603437)

Sodium is important to reentry because of its contributions to radiation and electron density. It is shown here that neither its radiation nor its electron density can be expected to be in equilibrium. The radiation is subject to considerable "collision limiting" (nonequilibrium excitation and deexcitation). The ionization processes cannot be assumed to be instantaneous and the deionization processes are very slow. The major reaction is the ionization–deionization system, found to be $Na + O \rightleftarrows Na^+ + O^-$, although other reactions, both of this type and other types, contribute appreciably, depending on the conditions. Included in this report is a recommended chemical system, with rate constants, for use in any nonequilibrium calculations of the effects of sodium in reentry. Author

N64-31005* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
VISIBLE ABSORPTION SPECTRA OF LITHIUM, SODIUM, AND POTASSIUM IN MOLTEN LITHIUM CHLORIDE–POTASSIUM CHLORIDE
J. Greenberg and I. Warshawsky Repr. from J. Am. Chem. Soc., v. 86, 5 Sep. 1964 p 3572–3574 refs
(NASA-RP-322)

The absorption spectra obtained upon the addition of lithium, sodium, and potassium to molten lithium chloride–potassium chloride were measured. Quartz curvettes, 1 cm in diameter, were used as containers. The spectra were obtained by use of a Beckman DK double-beam recording spectrophotometer. All measurements were made at 400°. All absorption spectra obtained were characterized by a single visible band with a peak maximum at about 530 mμ. No additional bands on structures were observed in the range 3000 to 15000 Å. A.W.

N64-31015 Iowa State U. of Science and Tech., Ames Ames Lab.
BIBLIOGRAPHY OF REVERSED-PHASE PARTITION CHROMATOGRAPHY
C. E. Hedrick and James S. Fritz Jul. 1964 20 p refs
(Contract W-7405-ENG-82)
(IS-950)

N64-31042 Tennessee U., Knoxville
OXIDATION OF CESIUM AT LOW TEMPERATURES Final Report
J. E. Epperson and E. E. Stansbury Arnold Eng. Develop. Center, Sep. 1964 62 p refs
(Contract AF 40(600)-1023)
(AEDC-TDR-64-195; AD-447385)

The rate of reaction of cesium with oxygen at reduced pressures, principally in the range of 10^{-4} to 10^{-6} torr, was measured at 0°, −35°, −63°, and −78° C. Samples of cesium were prepared for oxidation by very slow three-stage vacuum distillation followed by final condensation on a cleaved surface or mica, which served as a substrate for the sample and from which the heat evolved in condensation was removed to an isothermal bath by means of a large silver heat conductor. A recording microbalance was used for continuous measurement of the weight change as a function of time for selected experimental conditions. Two survey runs were made at oxygen pressures of 1×10^{-2} and 5×10^{-1} torr. The rate curve for the latter oxygen pressure was entirely different in form from any determined at the lower pressures. Author

N64-31056 California U., Livermore. Lawrence Radiation Lab.
CHEMICAL REACTIVITY TESTING OF EXPLOSIVES
J. W. Frazer and K. Ernst 18 Jul. 1963 22 p refs
(Contract W-7405-ENG-48)
(UCRL-7438) OTS: $0.50

This paper describes a chromatographic testing method that overcomes some of the weaknesses of the one-parameter tests. Its important feature is the quantitative determination of the volatile decomposition of reaction products, solvents, and other compounds. The progress of the reaction can be studied as a function of time, temperature, and material environment. A.W.

N64-31061 Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 31, 1964
F. L. Culler et al Oct. 1964 319 p refs
(Contract W-7405-ENG-26)
(ORNL-3627) OTS: $4.00

A summary of work in the following areas is presented: (1) power-reactor fuel processing; (2) fluoride volatility processing; (3) waste treatment and disposal; (4) transuranium element processing; (5) curium processing; (6) development of the thorium fuel cycle; (7) separations chemistry research; (8) recovery of fission products by solvent extraction; (9) chemistry of protactinium; (10) radiation effects of catalysts; (11) high-temperature chemistry; (12) mechanisms of separations processes; (13) ion exchange—radiation damage to ion-exchange resins; (14) chemical-research engineering; (15) decontamination of equipment; (16) reactor-evaluation studies; (17) chemical applications of nuclear explosions; (18) assistance programs such as Eurochemic assistance programs and engineering assistance; (19) chemical processing for the molten-salt reactor experiment; and (20) water-research programs. I.v.L.

N64-31092 London U. (Gt. Brit.) Royal Holloway Coll.
ADSORPTION OF FLUOROCARBONS ON POROUS SOLIDS Final Report
O. E. Facey [1964] 19 p refs
(Contract DA-91-591-EUC-2704)
(AD-601718)

Techniques, adsorbents, and adsorbates used are discussed briefly. An apparatus that uses surface tension and interferometry to measure pore size is discussed at length, and a corrected equation for pore radius is derived. The isothermal curves for adsorption of perfluorobutanol and 2-fluoroethanol on silica gel, perfluorobutanol on ferric oxide II, and 2-fluoroethanol on ferric oxide IV have been obtained at 25° C. They are all of the normal sigmoid shape and correspond to type IV of Brunauer's classification. These isotherms were reproducible over several cycles of adsorption and desorption. Tables and graphs for these isotherms are given. D.E.W.

N64-31093 Tulane U., New Orleans, La.
STUDIES OF THE COMPLEXES FORMED BETWEEN THE 5-TRIFLUOROMETHYLTETRAZOL ANION AND SOME DIVALENT TRANSITION METAL IONS; MAGNETOCHEMICAL AND SPECTRAL STUDIES OF SOME COPPER (II) COMPLEXES OF SUBSTITUTED BENZOIC ACIDS; COPPER(II) HALIDE COMPLEXES WITH SUBSTITUTED PYRIDINE N-OXIDES Final Status Report
A. D. Harris, H. B. Jonassen, T. L. Mallory, S. R. Smith, K. Bergeret et al 25 Jul. 1964 70 p refs
(Contract Nonr-47509)
(SR-9; AD-603081)

Complexes of Co(II), Ni(II), and Cu(II) with the 5-trifluoromethyltetrazole anion were prepared, and their reflectance spectra were measured. The D.T.A. studies of these complexes give an indication of the relative order of stability. The decomposition of these complexes has been followed on a time-of-flight mass spectrometer and compared with that of the sodium salt of 5-trifluoromethyltetrazole. Differences in behavior correlate with the reflectance and infrared spectra of these compounds. Conductometric studies of the interaction of this anion with the metal salts indicate a possible mechanism of complex formation. Author

N64-31107 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE SEPARATION OF OXYGEN ISOTOPES IN THE ELECTRO-SYNTHESIS OF OZONE
I. A. Semiochin, G. M. Pancenkov, and V. K. Korovkin 3 Aug. 1964 12 p refs Transl. into ENGLISH from Kernenergie (Dresden), no. 4/5, 1962 p 300–303
(FTD-TT-64-326/1+2; AD-447340)

By an example of the electrosynthesis of ozone it is shown that the change in the isotope composition in electrogas reactions with a great isotopic effect (the order of magnitude of 10%) takes place in fractions of a second. A mechanism of the separation of oxygen isotopes in connection with ozone electrosynthesis is proposed. Author

N64-31112 Monsanto Research Corp., Everett, Mass. Boston, Labs.
RESEARCH TO IMPROVE ELECTROCHEMICAL CATALYSTS Semi-Annual Technical Summary Report, 15 May–15 Nov. 1963
J. O. Smith, R. G. Gentile, E. A. Mc Elhill, J. J. O'Connell, and D. L. Williams 15 Jan. 1964 56 p refs
(Contract DA-44-009-AMC-202(T); ARPA Order 437)
(MRB-40125A1; AD-434194)

The ability of metal chelates to catalyze the electrochemical oxidation of both soluble and insoluble fuels was demonstrated. Twenty-one metal chelates were prepared, purified, and tested as catalysts for the oxidation of hydrazine and formic acid. Of these, 19 were active catalysts for the oxidation of hydrazine, and 11 were active for the oxidation of formic acid. Five chelates have been active catalysts for the electro-oxidation of

hydrogen at 90° C. Testing of these catalysts for the oxidation of propane is just beginning. Although none of the catalysts tested thus far were active for propane oxidation at 90° C, some probable activity was noted with copper phthalocyanine at 155° C in phosphoric acid. Author

N64-31113 General Dynamics/Astronautics, San Diego, Calif. Space Sciences Lab.
PREPARATION OF ACCURATE TEST GAS MIXTURES
E. R. Bartle and E. A. Meckstroth Jul. 1964 24 p refs
(Contract DA-04-495-ORD-3383(Z); ARPA Order 393; Proj. Defender)
(GDA-DBE-64-044; AD-444499)

Chemical kinetic studies of CO_2 formation led to the requirement of preparing accurately known, prescribed test gas mixtures. Techniques have been developed for the purification of reagent-grade gas components to minimize undesirable impurities, the accurate determination of the resulting mole concentrations, and the ability to add very small prescribed minor constituents to a test gas mixture. Concentrations may be determined within 1% using partial pressure measurements for C > 7% and within 2% using gas chromatographic analysis for C > 50 ppm. A series of test gas mixtures of argon-diluted CO, O_2, and H_2 have been prepared, and the concentrations were found to be within 2% of those desired. Presently, mixtures are being prepared where the H_2 concentration will be held constant and equal to 110 ppm. Author

N64-31234 Harvard U., Cambridge, Mass.
A STUDY OF N-METHYL SUBSTITUTED SILAZANES AND Si-N COMPOUNDS COMPRISING THE $Si\text{-}CH_2\text{-}Si$ GROUPING
Klaus Lienhard [1963] 50 p refs
(Contract Nonr-1866(13))
(AD-420486)

Synthesis of linear N-methyl silazanes could not be achieved. Several cross-linked products formed in the attempted synthesis are discussed. Compounds of the type $R_2N\text{-}SiMe_2\text{-}C_6H_4\text{-}SiMe_2\text{-}NR_2$ were investigated in an attempt to replace by a methylene group, the phenylene group between the two silicon atoms. The compound $Br\cdot SiMe_2\cdot CH_2\cdot SiMe_2\cdot Br$ was obtained, and its reaction with several amines is discussed. P.V.E.

N64-31265 Thiokol Chemical Corp., Denville, N.J. Reaction Motors Div.
DIELECTRIC MATERIALS FOR HIGH TEMPERATURE APPLICATION, 15 MAY–1 SEPTEMBER 1963
Joseph Green and Nathan Mayes [1963] 19 p refs
(Contract NObs-88318)
(RMD-5026-F; AD-420632)

Research was conducted on the preparation of thermally stable carborane silicone materials for use as embedding compounds and elastomers. End-blocked carborane silicones were prepared for use as plasticizers. Work was continued on the preparation and isolation of cyclosiloxanes and carborane derivatives of cyclosiloxanes. The electrical properties at high temperature and the thermal stability of the carborane silicone polymer were investigated. Fiberglass cloth laminates were prepared from the carborane silicone polymer, and adhesion to metals was investigated. Author

N64-31271 Battelle Memorial Inst., Columbus, Ohio
SYNTHESIS, FABRICATION, AND CHEMICAL REACTIVITY OF PLUTONIUM MONONITRIDE
William M. Pardue, Victor W. Storhok, Roy A. Smith, Paul H. Bonnell, John E. Gates et al 15 Sep. 1964 43 p refs
(Contract W-7405-ENG-92)
(BMI-1693) OTS: $1.00

Synthesis of PuN using a hydride–nitride cycle was found to be the most suitable preparation technique. Dense PuN specimens were fabricated by an isostatic hot-pressing technique in which consolidated powder sealed in a refractory-metal container was subjected to 10,000-psi external gas pressure at 1,370° to 1,540° C for 3 hr. Density and microhardness increased with increased isostatic hot-pressing temperature. Minus 80-mesh PuN powder was completely converted to oxide in 1 to 3 days in air, and increased in oxygen content from 4,700 ppm to 2.252 wt. % when stored in a nitrogen–1% oxygen glovebox atmosphere for 30 days (both tests conducted at room temperature). Attack of Pun by the common acids decreased in the sequence HNO_3, HCl, N_3PO_4, H_2SO_4, and HF. PuN appeared compatible with sodium and lithium at temperatures up to at least 800° C but was disintegrated by these metals in the 950° to 1,000° C temperature range. PuN was compatible with iron-base alloys, Inconel, and refractory metals at temperatures of 1,300° C. Author

N64-31281 Massachusetts Inst. of Tech., Cambridge School of Engineering
ELECTROCHEMICAL OXIDATION OF FORMIC ACID
Robert Slott Jan. 1963 178 p refs
(Contract Nonr-1841(78); ARPA Order 214-62)
(SR-5; AD-401932)

This investigation was undertaken to obtain a better understanding of the mechanism of the electrochemical oxidation of formic acid on a plain platinum electrode. Attention was focused on the unusual voltage behavior observed in formic acid solutions, namely the minimum open circuit potential observed after an oxide was caused to form on the platinum electrode and the rise in potential at open circuit after this minimum potential had developed. Experiments were carried out to determine the effect of pretreatment on subsequent electrode performance and to gain insight into the nature of the galvanostatic voltage oscillations observed with formic acid solutions. Author

N64-31284 Engelhard Industries, Inc., Newark, N.J. Research and Development Div.
PARA ORTHO CONVERSION OF HYDROGEN Quarterly Report, 30 Jan.–30 Apr. 1964
A. J. Haley and S. G. Hindin [1964] 24 p ref
(Contract AF 33(657)-11125)
(QR-3; AD-447073)

Ruthenium catalysts supported on silica–alumina can be prepared showing activities comparable to the highly active carbon-supported ruthenium catalyst described previously. The silica–alumina-supported catalysts contain less than half the amount of ruthenium in the carbon-supported catalyst, i.e., 10% by weight versus 25%. The correlation between catalyst activities and actual ruthenium metal areas appears to hold for both the carbon-supported and the silica–alumina supported catalysts. Author

N64-31288 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency
WORKING GROUP ON ANALYTICAL CHEMISTRY Minutes of the First Meeting

Feb. 1964 29 p Proc. of a Meeting held at St. Paul. 30 Jul.–1 Aug. 1963
(Contract NOw-62-0604-C)
(CPIA-PUBL-30A; AD-447075)

Included are reports of the following study groups and/or committees: (1) Nitroxy group; (2) chemical stability; (3) liquid-propellant subgroup of the analytical-chemistry working group; (4) infrared committee; (5) uv and visible spectroscopy committee; (6) surveillance and aging committee; (7) committee on gas chromatography; (8) military-specifications committee; (9) committee on thermal methods; (10) X-ray-analysis committee; (11) subcommittee on micrometrics; and (12) rf spectroscopy committee. P.V.E.

N64-31293 Naval Radiological Defense Lab., San Francisco, Calif.
GAMMA RADIATION EFFECTS ON ISOPRENOIDS. II: 2,6-DIMETHYLOCTANE AND 2,6-DIMETHYLOCTADIENE-2,6
W. E. Shelberg 20 Sep. 1963 29 p refs
(USNRDL-TR-691; AD-426974)

The radiolytic decomposition of 2,6-dimethyloctadiene-2,6 and 2,6-dimethyloctane, respectively, models for rubber and hydrorubber, was investigated. Yields of hydrogen gas and hydrocarbons through C_5 were determined at low conversions. For both models, hydrogen gas was attributed to abstractions by "hot" and lesser energetic hydrogen atoms and to hydrogen molecule detachments. There were 19 hydrocarbon products found for the diene and 20 for the paraffin. Yields from the diene are generally smaller than those from the paraffin. The formation of hydrocarbon products from the diene is interpreted by means of radical reactions involving little or no diffusion. The formation of hydrocarbon products from the paraffin is interpreted by means of radical reactions involving caging as well as free diffusion. Author

N64-31295 Bureau of Mines, Salt Lake City, Utah
SOLVENT EXTRACTION RECOVERY OF THORIUM AND YTTRIUM FROM SILICEOUS COLORADO ORES
S. R. Borrowman and D. W. Bridges 1964 20 p refs
(BM-RI-6457)

Processing comprised acid curing and subsequent acid baking, leaching, and solvent extraction of thorium, using a primary alkylamine, and yttrium, using di-2-ethylhexyl phosphoric acid. About 95% of the contained thorium and yttrium was recovered from ore containing 1.2% ThO_2 and 0.5% Y_2O_3. The thoria product was 99% ThO_2; the yttria product was 77% Y_2O_3. A 150-to-1 concentration ratio was effected on the latter, but some contaminating lanthanon-group oxides remained. Author

N64-31297 Copenhagen U. (Denmark) Inst. for Physical Chemistry
WEAK INTERACTION MODEL FOR DISSOCIATION OF DIATOMIC MOLECULES
Knud Andersen and Thor A. Bak 30 Mar. 1962 17 p refs
(Contract AF 61(052)-133)
(TN-6; AD-278380)

Calculations of the absolute values of the rate constants for the gas phase reaction $A_2 + M \rightleftarrows 2A + M$ are performed, assuming a weak interaction between the diatomic molecule A_2 and the inert gas M. The potential in the diatomic molecule is assumed to be a cutoff harmonic potential, and the potential between the two ends of the diatomic molecule and the gas atoms is assumed to be the Lennard–Jones 6–12 attraction potential. It is found that the rate constants calculated in this way are far too small, and that they have an incorrect mass dependence. It is concluded that the weak interaction must play a negligible role for chemical dissociation reactions in the gas phase. Author

N64-31317 California U., Riverside
MECHANISM STUDIES WITH BORONHYDRIDES Sixth and Seventh Quarterly Summary Reports, 1 Nov. 1963–31 Mar. 1964
M. Frederick Hawthorne [1964] 3 p
(ARPA Order 366-62)
(QSR-6; QSR-7; AD-447836)

The reaction kinetics of $B_{10}H_{10}^{-2}$ ion formation from $B_{10}H_{10}(ligand)_2$ compounds has been extended to a study of $B_{10}H_{12}(SMe_2)_2$ in toluene at 0° and in acetonitrile at 29.9°. The chemistry of $B_{20}H_{18}^{-2}$ has been improved by the acquisition of 60-Mc ^{11}B NMR spectra of key compounds. Particular attention was given to a study of the B_{20} isomerization reaction reported for $B_{20}H_{17}OH^{-4}$ ions. Determination of the pK_A of *meta*- and *para*-carboranyl-anilinium ions was completed. The C-phenyl derivative of the recently reported $B_9C_2H_{12}$-ion has been resolved into its enantiomeric components. P.V.E.

N64-31320 Atomic Energy Commission, New York, N.Y. Health and Safety Lab.
MANUAL OF STANDARD PROCEDURES
John H. Harley Washington, AEC, Sep. 1964 285 p refs
(NYO-4700, Suppl. 1) OTS: $7.00

Included are inserts for the "Manual of Standard Procedures," consisting of material on radiochemical analysis, radiation measurements, chemical procedures, and fallout collection and analysis methods. R.L.K.

N64-31322 Radley (J.A.) Research Inst., Reading (Gt. Brit.)
STUDY OF THE ESTIMATION OF CERTAIN TRACE IMPURITIES BY FLUORIMETRIC METHODS, PART I Final Technical Report, 1 Apr. 1963–31 Mar. 1964
A. R. Dale, G. Elliot, and J. A. Radley 10 Jun. 1964 71 p refs
(DA-91-591-EUC-2856)
(FTR/1/GE, Pt. 1; AD-603512)

A comprehensive literature survey of the known fluorimetric reagents for aluminum, magnesium, and silicon has been carried out. Another extensive survey of separation methods has also been made, to determine the best techniques for segregating microgram quantities of Al, Mg, or Si from gram quantities of Ni, Ti, Mo, Ta, W, Re and the compound semiconductors. The more sensitive reagents for aluminum at present appear to be the formylhydrazones of resorcylaldehyde or salicylaldehyde and for magnesium, bis-salicylidene ethylene diamine. Further work has been carried out on the benzoin-mannitol reagent for silicon, but more development is required before this reagent can be made reliable for the estimation of 1 μg or less. Author

N64-31323 Radley (J.A.) Research Inst., Reading (Gt. Brit.)
STUDY OF THE ESTIMATION OF CERTAIN TRACE IMPURITIES BY FLUORIMETRIC METHODS, Part 2 Final Technical Report, 1 Apr. 1963–31 Mar. 1964
A. R. Dale, G. Elliott, and J. A. Radley 10 Jun. 1964 107 p refs For abstract see N64-31322 22-07
(DA-91-591-EUC-2856)
(FTR/2/GE, Pt. 2; AD-603513)

N64-31334* National Aeronautics and Space Administration, Washington, D.C.
METHOD OF BONDING FLUORINATED POLYMERS [ZPUSOB LEPENI FLUOROVYCH POLYMERU]

Milan Peterka and Vladimir Brajko Aug. 1964 5 p Transl. into ENGLISH of Czech Patent no. 94701, 31 May 1958
(NASA-TT-F-9070) OTS: $1.00 fs; $0.50 mf

A method of bonding fluorinated polymers to unimproved surfaces by using pressure-sensitive bonding materials is presented. Polyvinyl ethers prepared from monomers containing epoxy groups are used as the bonding materials, the most suitable being polyvinyl isobutyl ether dissolved in chlorinated hydrocarbons or ether. The bonding material is used with inorganic fillers (e.g., SiO_2, TiO_2, or ZnO). P.V.E.

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-30220 Joint Publications Research Service, Washington, D.C.
THE DETERMINATION OF PARAMETERS OF GROUPS OF A RANDOM NUMBER OF SIGNALS UNDER NOISE CONDITIONS
I. A. Bol'shakov *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 120–135 refs (See N64-30207 22-01) OTS: $6.00

With the use of an apparatus of correlated random points, the a posteriori probability is formulated for the value of the parameter of a group consisting of a random number of statistically identical signals. The operator and characteristics of the statistical evaluation of the parameter group are given. The a posteriori characteristics of the set of parameters of statistically identical groups are obtained where these parameters are random points themselves. On the basis of risk theory the optimal operator is constructed for the simultaneous discovery of groups and the determination of their parameters. Author

N64-30397 Stanford U., Calif. Systems Techniques Lab.
A TAPE-RECORDER, TRANSIENT-RESPONSE EQUALIZER Technical Report No. 1807-5, Mar.–Jun. 1963
R. L. Mc Master Aug. 1963 22 p refs
(Contract AF 33(657)-11144)
(SU-SEL-63-129; AL-TDR-64-2; AD-602707) OTS: $1.00

The theory and operation of a simple phase equalizer that will correct much of the phase or delay distortion produced by instrumentation and audio tape recorders is described. This distortion degrades the pulse response by providing different time delays for various frequency components of a pulse or transient waveform. Compensation has also been provided for sag and ringing on rectangular waveforms. This adjustable equalizer has been designed to be used on the playback output of direct-record tape recorders. Operation of the equalizer is described in the appendix. Author

N64-30456 Mitre Corp., Bedford, Mass.
RF POWER ALLOCATION FOR A UNIFIED TELEMETRY SYSTEM
L. L. Stine Jun. 1964 20 p refs
(Contract AF 19(628)-2390)
(W-06827/0000/00/0/00; ESD-TDR-64-104; AD-602455)

The document describes the power spectrum of an RF carrier phase modulated by several frequency-multiplexed signals. It is proved, in text and in illustration, that an improvement in power allocation is possible by modulating one signal on a separate RF carrier. Author

N64-30476 Aberdeen Proving Ground, Md. Ballistic Research Labs.
SHOCK TUBE TEST OF A HORN ANTENNA
George A. Coulter Oct. 1963 41 p refs
(BRL-1515; AD-439833) OTS: $4.60

The results from air shock loading a model of an inverted horn reflector type antenna are given for incident nominal shock overpressures of 50, 100, and 160 psi. The data are presented in the form of pressure—time traces obtained from piezoelectric transducers flush-mounted at several points on the interior walls of the model. Author

N64-30485 Ohio State U. Research Foundation, Columbus Antenna Lab.
RESEARCH ON TECHNIQUES FOR INTEGRATION OF ACTIVE ELEMENTS INTO ANTENNAS AND ANTENNA STRUCTURE Interim Report, 1 Mar.–31 May 1964
J. F. Rippin, Jr. 1 Jun. 1964 21 p refs
(Contract AF 33(657)-10386)
(Rept.-1566-11; AD-442625)

The design of a 420-mc integrated coaxial-transistor amplifier and T-bar slot antenna is discussed. A 1,000-mc integrated direction-finding system that employs a lobe-switching log-periodic dipole array is described. Preliminary tests on a four-element array of dipoles with electronic phase and amplitude control are discussed. Author

N64-30507* Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOGUE OF SATELLITE OBSERVATIONS, NO. C-39
Beatrice Miller 18 Jun. 1964 83 p
(Grant NsG-87-60)
(NASA-CR-58821; SAO-155) OTS: $3.00 fs; $0.75 mf

The satellite observations cataloged in this volume are: (1) 1961 Omicron 1 (Transit 4A), Jan. 1 through June 30, 1963; (2) 1961 Omicron 2 (Injun Solar Radiation 3), Jan 1 through June 30, 1963; (3) 1962 Upsilon 1 (Cosmos 5), March 11 through April 30, 1963; (4) 1962 Alpha Epsilon 1 (Telstar 1), Jan. 1 through June 30, 1963; (5) 1962 Beta Mu 1 (Anna 1B), Jan. 1 through June 30, 1963; (6) 1962 Beta Tau 2 (Injun 3), Jan. 16 through June 30, 1963; (7) 1962 Beta Upsilon 1 (Relay 1), Jan. 4 through June 30, 1963; (8) 1963 9 A (Explorer XVII), Apr. 6 through June 24, 1963; and (9) 1963 13 A (Telstar 2), May 11 through June 30, 1963. M.P.G.

N64-30514 Chu Associates, Littleton, Mass.
MULTIPLE PLATE ANTENNA ANALYSIS Scientific Report No. 1
10 Dec. 1963 75 p refs
(Contract AF 19(628)-297)
(AFCRL-63-58-5)

The multipleplate, antenna-system concept is covered in detail. General design parameters are examined, and design equations formulated. Specific design approaches in the major design areas are discussed. The system requirements covered in this report include antenna design requirements, computer requirements, antenna plate, mechanical design, and the antenna drive system. Author

N64-30523* Pennsylvania State U., University Park Ionosphere Research Lab.
SECOND-ORDER EFFECTS IN HIGH-FREQUENCY TRANSIONOSPHERIC PROPAGATION Scientific Report No. 216
W. J. Ross 10 Aug. 1964 50 p refs
(Grant NsG-114-61)
(NASA-CR-58797) OTS: $2.00 fs; $0.50 mf

This paper presents an analytical derivation of second-order effects, in a form suitable for manual data reduction, and including the effects of nonlinear refractive index, ray path bending, and magnetoionic mode splitting. Application of the equations to ionospheric models shows order-of-magnitude error reduction as compared to first-order analysis methods. The significance of the results in experiments involving phase path dispersion and polarization rotation dispersion is discussed. Author

N64-30530 Aerospace Corp., El Segundo, Calif.
TRACKING, TELEMETRY, AND COMMAND STUDIES OF GROUND AND SATELLITE SUBSYSTEMS. VOLUME II: A COMPARISON OF SEVERAL RANGING SYSTEMS DESIGNED FOR MILITARY SPACE APPLICATIONS
H. Anderson and A. Shapiro May 1964 104 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-334, Vol. II; TDR-269(4110-01)-13, Vol. II; AD-446670)

A comparison is made of three continuous-wave ranging systems: (1) fixed-tone ranging; (2) swept-tone ranging; and (3) pseudorandom code ranging. The comparison is based on sample system designs using each of the three techniques. Each system design is based on a set of requirements that is typical for military space application. Key system parameters are identified for each type of system. Author

N64-30587 Michigan U., Ann Arbor Inst. of Science and Technology
DATA REDUCTION BY COHERENT OPTICAL SYSTEMS
A. Vanderlugt and F. B. Rotz Aug. 1964 22 p refs
(Contract DA-36-039-SC-78801)
(Rept.-2900-466-R; AD-446626)

This paper emphasizes some new developments that have bearing on data reduction, and refers briefly to the theory behind coherent optical systems. Of particular interest is the development of a technique that allows more general operations by linear filtering. Examples of spectral analysis and character recognition are presented. Author

N64-30588 Michigan U., Ann Arbor Inst. of Science and Technology
BEYOND-LINE-OF-SIGHT DATA TRANSMISSION USING ADAPTIVE ARRAY TECHNIQUES
Frank E. Wilburn Aug. 1964 41 p refs
(Contract DA-36-039-SC-78801; Proj. Michigan)
(Rept.-2900-491-T; AD-446155)

State-of-the-art developments in adaptive array techniques applied to beyond-line-of-sight data transmission systems are reported. The general theory of beam-steering by means of a directional reference derived from received energy incident on the array elements is reviewed. The Van Atta method of connecting conjugate pairs of array elements and the phase-inversion principle of terminating each receiver element in a phase-inverting device are examined in detail. For each method, array configurations (i.e., planar array, curved array), element spacing, and the effects of polarization are discussed. Consideration is also given to the following areas (with particular emphasis on their applicability to beyond-line-of-sight relays): types of modulation compatible with adaptive arrays, isolation schemes, and frequency offset. Author

N64-30592 Watkins-Johnson Co., Palo Alto, Calif.
RADIO INTERFERENCE MEASURING SET AN/URM-100 (XE-1) Quarterly Progress Report No. 4, 26 Mar.–25 Jun. 1964
William E. Budd, Robert C. Hilquist, Marshall H. Hollimon, Dale E. Miller, Lawrence W. Polson et al [1964] 54 p
(Contract DA-36-039-AMC-02328(E))
(QTR-4; AD-446644)

The YIG drivers for all 12 filters have been completed, and recent tests indicate overall filter-driver time constants of better than 20 μsec in both X- and S-band. An X-band BWO has been tested in the local oscillator circuit and, after initial adjustment, exhibited better than ±0.1% linearity with about 30 KC peak-to-peak incidental FM and a drift rate of ±50 Kc/hour. The final model fast-tuning YIG devices are near completion. Reducing spurious responses, especially in C-band, as well as tracking errors has been a source of delay, and these problems are also reported upon. Author

N64-30600 Lincoln Lab., Mass. Inst. of Tech., Lexington
CHARACTERIZATION AND MEASUREMENT OF TIME- AND FREQUENCY-SPREAD CHANNELS Technical Report No. 352
R. G. Gallager 30 Apr. 1964 36 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-56; AD-443715)

This report deals with the characterization and measurement of channels in which the input waveform is subject to both additive noise and to time and frequency spreading. Many spread channels are adequately characterized by any one of three functions of two variables: the scattering function, the tap-grain correlation function, and the two-frequency correlation function. These quantities are carefully defined and related by Fourier transform relationships. A number of interpretations are given for these functions, and the physical circumstances in which the functions provide meaningful characterizations of the channel are discussed. Techniques are given for measuring each of the functions. Author

N64-30620 Joint Publications Research Service, Washington, D.C.
THEORY OF THE PROPAGATION OF SUPERLONG WAVES
P. Ye. Krasnushkin and N. A. Yablochkin 22 Sep. 1964 117 p refs Transl. into ENGLISH of the book "Teoriya Rasprostraneniya Sverkhdlinnykh Voln" Moscow, Computer Center of the Acad. of Sci. USSR, 1963 p 1–64
(JPRS-26502; TT-64-41760) OTS: $4.00

This book on the theory of the propagation of superlong waves consists of the following chapters: (1) "Statement of the Problem and Selection of the Model of the Medium"; (2) "Solution of the Boundary-Value Problem of the Propagation of SDV Propagation on the Basis of Models B and C"; (Model B differs from Model A—a generalization of the Watson waveguide model for a case considering the vertical component of the magnetic field of the earth—in the fact that the undulating nature of the ionospheric layer is considered. Model C considers the facts of slow changes in the radii of the layers and their electric properties, depending upon the geometric coordinates. (3) "Introduction of Additional Initial Data Obtained from Measurements of the Amplitude and Phase of Short-range SDV Fields, and the Results of the Theory with Respect to the Ionosphere"; (4) "Basic Characteristics of Normal Wave Number of the First Numbers"; and (5) "Calculation of the Regular Dependence of the Amplitude and Phase of the Long-range SDV Field upon Time and Distance." In the above, SDV refers to decakilometer waves around the earth. I.v.L.

N64-30633 Cornell U., Ithaca, N.Y. Electrical Engineering Research Lab.
DESIGN AND CONSTRUCTION OF A MATCHED FILTER

T. Parks Apr. 1964 65 p refs
(Contract DA-36-039-AMC-00034(E))
(RR-EERL-6; AD-601983) OTS: $6.60

This research concerned the design, construction, and evaluation of a laboratory model of a wideband filter matched to a seven-pulse code. A modified link structure with two grid lines provided for both positive and negative coefficients. The grid and plate lines, designed for maximally flat delay, were constructed by cascading constant-resistance all-pass networks, based on the unbalanced lattice. The measured ratio of central to side peaks was about 80 percent of the theoretical value. Author

N64-30639 SHAPE Air Defense Technical Center, The Hague (Netherlands) Systems Research Div.
THE ACCURACY OF RADAR RANGE MEASUREMENTS USING NON-OPTIMUM FILTERS
V. Gregers Hansen Mar. 1964 30 p refs
(TM-97; AD-443786)

The case of a rectangular transmitted signal waveform as used in conventional radars introduces certain difficulties in theoretical calculations, since under ideal conditions a zero variance range (delay) estimate should be possible. Previously, this difficulty was overcome by assuming a signal pulse with finite rise times, but the assumption of the availability of a matched filter was maintained. In the present report the matched filter assumption has been abandoned and a formula for the theoretical accuracy is derived for this suboptimum case. The specific case of a rectangular pulse and a gaussian filter is then considered, and theoretical results are compared with measurements carried out for this case. Author

N64-30691 Johns Hopkins U., Baltimore, Md. Carlyle Barton Lab.
STUDY OF HIGH RESOLUTION RADARS AND ECM VULNERABILITY, VOLUME II Interim Engineering Report No. 10, 1 Apr.–30 Jun. 1964
R. F. Rychlik 1 Jul. 1964 156 p refs
(Contract AF 33(657)-7967)
(IER-10, Vol. 2; AD-442547)

The design and performance characteristics of a time-invariant predetection filter are presented. The filter is to be used for the detection of a signal pulse of unknown amplitude, in the presence of additive gaussian noise of unknown power spectrum. The predetection filter is first envisaged as a parallel set of channels, each passing a different frequency band of the input, limiting it, and linearly filtering it again, after which the channel outputs are summed. The characteristics of the linear filters in each channel are then chosen to maximize the ratio of ensemble average peak signal to rms noise at the output. The resulting design is equivalent to a nonlinear prefilter followed by a filter that is matched to the desired input signal. D.E.W.

N64-30734 New Mexico U., Albuquerque Engineering Experiment Station
THE DRIVING-POINT IMPEDANCE OF AN ELECTRICALLY SHORT CYLINDRICAL ANTENNA IN THE IONOSPHERE
William E. Blair Jun. 1964 156 p refs
(Contract Nonr-2798(01) FBM)
(TR-EE-109; AD-602838) OTS: $5.00

This analysis presents a theoretical study of the driving-point impedance of a cylindrical antenna imbedded in the ionosphere. The antenna model is a cylindrical, center-fed, perfectly conducting antenna. The ionosphere model is a homogeneous, anisotropic, neutral cold plasma (magneto-ionic) medium. The anisotropy is caused by the earth's magnetic field, which is assumed to be uniform in the vicinity of the antenna. The antenna driving-point impedance is calculated for the antenna oriented both parallel to and perpendicular to the earth's magnetic field. The results are valid for all frequencies below HF, with special emphasis on the VLF spectrum. Author

N64-30736 National Cash Register Co., Dayton, Ohio
HIGH FREQUENCY DIGITAL COMMUNICATION SYSTEM AN/GRC(XW-3) AND CV-1355(XA-1)/ARC Final Engineering Report, Mar. 1960–Mar. 1964
Wright-Patterson AFB, Ohio, Systems Group, 19 Jun. 1964 237 p refs
(Contract AF 33(600)-42197)
(NCR-3F; SEG-TDR-64-26; AD-602808) OTS: $7.00

The High Frequency Digital Communication Systems consists of an airborne digital-to-digital converter and the ground station receiving and transmitting equipment. Briefly, the digital-to-digital converter accepts standard Fieldata code at 50 bits per second and converts the 20 millisecond marks and spaces into a series of 6 2/3 millisecond $\cos^2$ shaped intermediate frequency pulses. During reception, the transceiver delivers the 6 2/3 msec pulses, distorted by the propagation path, to the airborne converter, which separates the received signal into the six subchannels so that mark/space decisions can be made on the basis of the sequence of the pulses. In the receive mode, the ground station equipment receives a QFM (quantized frequency modulated) pulse, demodulates it, and converts the information to digital bits which are applied to the terminal equipment that supplies the information readout. In the transmit mode, the terminal equipment supplies digital bits to the ground station data converting equipment. These information bits are timed, modulated, and transformed to 300-kc QFM pulses that are supplied to the high-frequency transmitter, which broadcasts the information on a 3-kc-wide channel. Author

N64-30739 Naval Research Lab., Washington, D.C. Radio Div.
FLIGHT TESTS OF THE OMEGA AIRCRAFT RECEIVER Interim Report No. 8
R. H. Smith, A. F. Thornhill, and M. F. Williams 3 Jun. 1964 38 p refs
(NRL-MR-1543; AD-443914)

Omega is a very-low-frequency (10.2 and 13.6 kc) long-range hyperbolic radio navigation system. Propagation studies have shown that six or eight stations should provide coverage of the entire earth. The performance study of the Mark I Omega aircraft receiver has been completed. The results indicate that the use of the Omega navigation system for aircraft is entirely practical. The Mark I aircraft receiver has given a superior performance in areas of reasonable signal strength ($>6\mu v/m$) and in reasonably low noise conditions. The performance deteriorates in high noise conditions, primarily in precipitation static. The performance study of the Mark II aircraft receiver is proceeding. The principal circuit additions in the Mark II are the use of automatic rate-aiding (aircraft heading and speed inputs) and the use of automatic dead-reckoning. Author

N64-30748 Queens U., Kingston (Canada)
SOME ANALYTICAL TECHNIQUES FOR A CLASS OF NON-GAUSSIAN PROCESSES
B. A. Bowen Jun. 1963 68 p refs
(Contract DRB 013011)
(RR-63-3)

This dissertation contains the results of a study of impulse noise interference in a simple communications receiver model. A review of the cumulant concept is presented, and an impulse

model is postulated. By means of Campbell's theorem, or a well-known extension to it, the cumulants are defined in terms of integrals of functions of the wave shape of the impulse events. Author

N64-30755 Joint Publications Research Service, Washington, D.C.
PROBLEM OF PROBABILITY OF RADIO COMMUNICATIONS THROUGH LAYER E_S
Yu. K. Chasovitin and S. G. Fesenko 23 Sep. 1964 6 p refs Transl. into ENGLISH from Elektrosvyaz' (Moscow), no. 8, 1964 p 77–78
(JPRS-26529; TT-64-41787) OTS: $1.00

An attempt is made to evaluate the probability of radio communication through layer E_s, on the basis of data of vertical sounding of the ionosphere in Rostov-on-Don during April 1958 through March 1959. The results are used to evaluate the importance of the sporadic E-layer in radio communication along a 2,000-kilometer route with the reflection point above Rostov-on-Don. The results show that the probability of radio communication through layer E_s in the daytime has a maximum in mid-April through mid-july, which is caused by a high probability of occurrence and sufficiently high values of cutoff frequencies of the E_s-layer as well as relatively low critical frequencies of the F_2 layer during this time. The results for the nighttime show two maxima for the radio-communication probability through layer E_s—in May through July, and in December. The first maximum (May through July) results from the high probability of occurrence of the E_s-layer and from the E_s-layer cutoff frequencies being sufficiently high, even in nighttime. The second maximum is due mainly to a considerable decrease in critical frequencies of the F_2-layer in winter nighttime. P.V.E.

N64-30773 Lincoln Lab., Mass. Inst. of Tech., Lexington
PROJECT WEST FORD PAYLOAD TELEMETRY SYSTEM Technical Report No. 343
W. T. Higgins, L. A. Jacobson, and J. B. Rankin 20 Jan. 1964 42 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-21; AD-602928) OTS: $2.00

The beacon track and performance telemetry system used in the various Project West Ford communication payloads is described. The dipole dispensing rate, the dispenser spin, tumble, and temperature, as well as the system power-supply voltage, were measured and transmitted to the West Ford sites by means of a pulse-duration modulation system. In addition, the telemetry transmitter served as a beacon for accurate ground-based radar tracking of the payloads. The most important system considerations were efficiency, low power, simplicity, and high reliability. A tabulation of the received data and the interpretation of the data are given. Author

N64-30797 Institute For Defense Analyses, Washington, D.C. Research and Engineering Support Div.
MULTIPLE ACCESS CAPABILITY OF A HARD-LIMITING COMMUNICATION SATELLITE REPEATER WITH SPREAD-SPECTRUM SIGNALS
Joseph M. Aein Apr. 1964 43 p refs
(ARPA SD-50)
(IDA/HQ-64-2498; P-121; AD-603027) OTS: $2.00

This paper formulates the problem of simultaneous signaling through a hard limiter with spread-spectrum sources as applied to the communications satellite. The Central Limit Theorem is liberally applied to yield approximate answers, but the framework of a more precise analysis is also outlined. A critique of the analytical assumptions and techniques concludes the paper. Author

N64-30812 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE UNIVERSE ON A PICTURE SCREEN
8 Jul. 1964 4 p Transl. into ENGLISH from Berliner Zeitung (E. Berlin), 5 Apr. 1963 p 5
(FTD-TT-64-78/1; AD-602688)

A statement is made of a proposed television apparatus that is able to operate under extreme conditions such as those that exist on the moon. It is suggested that this television will be new in principle. A.W.

N64-30832* Consultants and Designers, I c., Arlington, Va.
THE USE OF A QUANTUM PARAMAGN TIC AMPLIFIER IN RADIO ASTRONOMY [PRIMENENIYE KVANTOVOGO PARAMAGNITNOGO USILITELYA V RADIOASTONOMII]
R. M. Martirosyan, A. M. Prokhorov, and R. L. Sorochenko 6 Aug. 1964 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 156, no. 6, 1964 p 1326–1328
(Contract NAS5-3760)
(NASA-TT-F-8938; ST-RA-10189) OTS: $1.00 fs; $0.50 mf

Observations of the results obtained when a quantum paramagnetic amplifier (QPA) was installed on a 22-meter radiotelescope during the observation of the neutral hydrogen radio line in the $\lambda = 21$-cm wavelength are discussed. The observations indicated that the use of a QPA provides the possibility of reliably separating tiny details in the profiles of radio waves, and consequently, of bringing to light the fine structure in hydrogen distribution. P.V.E.

N64-30847* Consultants and Designers, Inc., Arlington, Va.
SIMULTANEOUS TRACKING OF THE BALLOON-SATELLITE ECHO-1 FOR GEODETIC PURPOSES [SINKHRONNYYE NABLYUDENIYA ISZ "EKHO-1" DLYA GEODEZICHESKIKH TSELEY]
D. E. Shchegolev, A. G. Masevich, and B. G. Afanas'yev 4 Sep. 1964 7 p Transl. into ENGLISH from Vestnik Akad. Nauk SSSR (Moscow), no. 7, Jul. 1964 p 74–77
(Contract NAS5-3760)
(NASA-TT-F-8954; ST-SSA-10201) OTS: $1.00 fs; $0.50 mf

One of the most promising methods of solving a series of problems of higher geodesy is that of cosmic triangulation. In cosmic triangulation if only one of the summits of each resolvable triangle does not lie on the earth's surface, it coincides, at a specific moment of time, with the position of a satellite; at the same time the sides of the triangles can be equal to thousands of kilometers. Author

N64-30860 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
KINETHEODOLITE OBSERVATION OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA, APRIL 1964, ISSUE 9
Apr. 1964 47 p

Universal time, elevation, and azimuth values are tabulated for observations during April of Explorer XIX satellite, two unidentified objects, and three unnamed orbital objects designated as 1963-30A, 1963-30D, and 1963-38A. D.E.W.

N64-30861* Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
KINETHEODOLITE OBSERVATION OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA, APRIL 1964, ISSUE 10
Apr. 1964 27 p

Universal time, elevation, and azimuth values are tabulated for observations during April of the Echo II satellite. D.E.W.

N64-30862 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
KINETHEODOLITE OBSERVATION OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA, MAY 1964, ISSUE 11
1964 46 p

Universal time, elevation, and azimuth values are tabulated for observations during May of Transit IB, the rocket body that launched Transit IIA and GREB, Echo I, Midas III, and the rocket body that launched Anna 1B, and two unnamed orbital objects designated as 1962 Kappa 1 and 1962 Beta–Kappa. D.E.W.

N64-30869 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
KINETHEODOLITE OBSERVATION OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM EARLY-BURN, DECEMBER 1963, ISSUE 4
1964 47 p

Universal time, elevation, and azimuth values are tabulated for observations during December of Midas IV, Ariel I, and Polyot I satellites, the Research Satellite for Geophysics, and nine other unnamed orbital objects designated 1962 Kappa 1, 1962 Sigma 1, 1962 Beta–Theta 1, 1963-3A, 1963-14A, 1963-17A, 1963-17G, 1963-22A, and 1963-38A. D.E.W.

N64-30870 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
KINETHEODOLITE OBSERVATION OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM EARLY-BURN, JANUARY AND FEBRUARY 1964, ISSUE 5
1964 33 p

Universal time, elevation, and azimuth values are tabulated for observations in January of the rocket body that launched Alouette, and of three unnamed orbital objects designated 1962 Beta–Theta I, 1963 30A, and 1963 30D. The same parameters are tabulated for observations in February of TIROS V, of the rocket body that launched ANNA 1B, and of five orbital objects designated as 1961 Alpha–Delta I, 1962 Beta–Kappa I, 1963 14A, 1963 30D, and 1963 49A. D.E.W.

N64-30871 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
KINETHEODOLITE OBSERVATION OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA, SEPTEMBER, OCTOBER AND NOVEMBER, 1963–1964, ISSUE 6
13 Sep. 1964 39 p

Universal time, elevation, and azimuth values are tabulated for observations during September of Explorer IX and of two unnamed orbital objects designated as 1963-30A and 1963-33B. Similar parameters are given by tables for observations during October of Midas III, Midas IV, and an unnamed object designated 1963-14A. Similar values are also given for observations in November for Transit IIA, the rocket body for Transit IIA, Midas III, Midas IV, Explorer XVI, Research Satellite for Geophysics, and three unnamed objects—1963-14A, 1963-30A, and 1963-33B. D.E.W.

N64-30872 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
KINETHEODOLITE OBSERVATION OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA, APRIL 1964, ISSUE 7
1964 28 p

Universal time, elevation, and azimuth values are tabulated for observations during April of Midas III, Transit IVA, and Midas IV satellites, and for two unnamed orbital objects designated as 1962 Kappa 1 and 1962 Alpha–Upsilon. D.E.W.

N64-30873 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
KINETHEODOLITE OBSERVATION OF SATELLITES RECEIVED BY THE PREDICTION SERVICE FROM MALTA, APRIL 1964, ISSUE 8
1964 35 p

Universal time, elevation, and azimuth values are tabulated for observations during April of Alouette, the rocket body that launched Alouette, Explorer XVI and two other unmanned orbital objects designated 1962 Beta–Kappa 1 and 1963-14A. D.E.W.

N64-30883 Technische Hochschule Darmstadt (W. Germany) Inst. für Allgemeine Nachrichtentechnik
INVESTIGATION OF THE ERROR STATISTICS OF PULSE DATA UNDER NON GAUSSIAN NOISE CONDITIONS Final Technical Report, 1 Oct. 1962–30 Apr. 1964
K. Küpfmüller 27 Jul. 1964 32 p
(Contracts DA-91-591-EUC-1964; DA-91-591-EUC-2700)
(AD-603461) OTS: $2.00

The report handles investigations on data transmission. Data sent on actual telephone circuits are often subjected to interference from random line noise. Noise recorded from heavily disturbed subscriber lines has been investigated. As types of data transmission systems, amplitude modulation and phase modulation were used. The transmission speed was 1800 baud. Error rates caused by various line noises are studied. Author

N64-30896 Technical U., Copenhagen (Denmark) Lab. of Electromagnetic Theory
NUMERICAL COMPUTATIONS BASED DIRECTLY ON THE COMPENSATION THEOREM OF THE SKY WAVE FIELD FROM A DIPOLE IN AN ARBITRARY FLAT MIXED LAND-SEA AREA Technical Note No. 7
Tove Larsen Mar. 1964 26 p refs
(Contract AF 61(052)-503)
(AFCRL-64-509; AD-603044)

In order to be able to treat the problem of propagation from an antenna placed in an arbitrary mixed land–sea area (height variations not taken into account), an investigation of the possibility of direct numerical integration of the compensation theorem was undertaken. The fitness of the various formulations of the compensation theorem, as well as the various approximations within this theorem, is discussed from the point of view of direct numerical integration. Computer programs for the final formulation are worked out and tested by comparing numerical results with the results of a more rigorous treatment of a simple configuration. Author

N64-30901 General Dynamics/Astronautics, San Diego, Calif.
RESEARCH DIRECTED TOWARD DEVELOPMENT OF A PROTOTYPE LUNAR TRANSPONDER, VOLUME II Final Report
A. E. Hunt 15 Sep. 1963 209 p refs
(Contract AF 19(628)-1609)
(GD/A-63-0933; AFCRL-63-765; AD-603272)

This report deals with the modification of the design of the General Dynamics–Astronautics GLOTRAC Type G Transponder. These modifications consisted of the following: (1) The harmonic generator was redesigned to a lower output power level, and the packaging concepts were aligned to the expected high shock level. (2) A 2-watt transistorized 104-Mc

power amplifier was designed for modular construction; (3) A stripline diplexer–mixer was designed to withstand the shock requirements and to provide reduced size. (4) Several modules were combined, and two were deleted. The deleted modules were the frequency discriminator and the 89-kc filter. It was determined that a 4-kc ranging modulation signal, replacing the standard 98 kc, would provide the desired range accuracy of ±1 km. Consequently, the 98-kc circuitry could be deleted. I.v.L.

N64-30971 Wisconsin U., Madison Mathematics Research Center
SLOWLY-VARYING CHANNELS AND SIGNAL DETECTION
W. L. Root May 1964 52 p refs
(Contract DA-11-022-ORD-2059)
(MRC-488; AD-605645)

The beginnings of a theory are established concerning time-varying and random linear channels, with the intent of characterizing classes of channels that can be determined exactly or approximately by measurement, showing how the measurements can be made, analyzing the errors, and applying the results to the theory of signal detection. The treatment is limited to channels that are slowly varying or that vary slightly around a known trend. Relations between almost-time-invariance of a channel and a certain kind of statistical stationarity are developed. The notion of a determinable channel is defined and developed, and classes of examples are given. Author

N64-30976 Raytheon Co., Wayland, Mass. Advanced Development Lab.
A NEW TECHNIQUE FOR SIMULTANEOUS RADAR OBSERVATION OF MULTIPLE TARGETS WITHIN A BROAD SURVEILLANCE REGION Scientific Report No. 2
Robert C. Distler and Frank A. Feldman Bedford, Mass., AFCRL, 31 Dec. 1963 36 p refs
(Contract AF 19(628)-361)
(AFCRL-64-696; AD-605765)

A new technique that permits simultaneous observation of multiple radar targets throughout a large volume of space has been investigated. In effect, this technique performs a transformation of the real target space into an analogous model space, which is directly observable and which preserves the quantitative details of the target parameters. This report presents the results of experimental and theoretical investigations into this technique. A preliminary design of system components is presented and evaluated. Author

N64-30985 Aerospace Corp., El Segundo, Calif. Electronics Div.
COMPOSITE CODED COMMUNICATIONS
C. S. Lorens and D. J. Braverman May 1964 31 p refs
(Contracts AF 04(695)-269; N123(60530)34804A)
(SSD-TDR-64-102; TDR-269(4540-80)-2; AD-605397)

This paper presents an investigation of the use of composite codes for the synchronization of coded, coherent communication systems. The paper considers composite transmitter codes that minimize synchronization time and composite receiver codes that maximize processing gain. Bounds on synchronization time are obtained as functions of the code uncertainty, probability of synchronization error, signal-to-noise ratio, and composite code degree. These bounds are compared with similar bounds on acquisition time required to construct the composite code when only the periods of the components are known. Author

N64-30986 Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
TARGET RESOLUTION: CAPABILITIES OF MODERN RADAR AND FUNDAMENTAL LIMITS
A. W. Rihaczek 27 Jul. 1964 47 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-107; TDR-269(4250-43)-2; AD-605221)

An interpretation is given of the radar uncertainty relation in its significance for target resolution, showing the role of waveform design as a means of achieving a match between the transmitted signal and the characteristics of the target environment. This provides a framework into which the various principles of high-resolution radar are fitted. In discussing the limitations on resolution performance, it is shown that achievable target resolution depends on the characteristics of the target environment in which the radar operates, the number of targets, and the size of the delay-doppler space they occupy. These findings are applied to two practical examples: (1) the ground mapping radar using the synthetic aperture principle and (2) the case of extended target "clouds" consisting of a large number of discrete scatterers. Author

N64-31014 Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
DESIGN OF A LASER DEEP SPACE COMMUNICATION SYSTEM
Kenneth L. Brinkman and William K. Pratt [1963] 54 p refs

A survey of the state-of-the-art of laser optical detectors, modulation devices, and methods, is given, which establishes the basic properties of the transmitter and receiver system components. Modulation and demodulation systems are analyzed theoretically, and the channel is characterized in terms of the noise contributions from stellar, planetary, and atmospheric background, as well as noise contribution from the components themselves. A systems analysis procedure is developed to select the transmission frequency and the type of receiver. Based on the selection, a choice is made between direct communications from the DSV and communications via a microwave relay satellite. Next, a choice is made of the optimum modulation method for present day systems for the communication link selected. This is followed by a preliminary design analysis of the selected communication system. A comparison of that system with a present day microwave system for interplanetary communications is made. Author

N64-31083 University of Southern Calif., Los Angeles
ON THE SEQUENTIAL DETECTION OF EMERGING TARGETS
R. M. Gagliardi and I. S. Reed May 1964 23 p refs
(Contract AF 04(695)-304)
(USCEE-109; SSD-TDR-64-191; AD-422044)

This report considers a maximum likelihood test for detecting emerging targets by sequential sampling. It is shown that the decisioning threshold must be continually increased in order to maintain a fixed false-alarm rate. An upper bound on the average number of samples required to detect an emerging target is computed, and the results are significant in that this bound may become quite large. A suboptimum test using only a finite number of past samples is also considered. The results of this study are equally applicable to the converse problem—detecting when a known target exists from the bin—which is important in target tracking. Author

N64-31097 University of Southern Calif. Engineering Center, Los Angeles
RESEARCH IN OPTICAL COHERENCE AND NONLINEAR ESTIMATION THEORY Final Report

Gregory O. Young, Clarence Giese, and Robert S. Macmillan
Dec. 1963 115 p refs
(Grant AF-AFOSR-188-63)
(USCEC-102-101; EE-34; AFOSR-64-1141; AD-601764)

CONTENTS:

1. RESEARCH IN OPTICAL COHERENCE p 1–45 refs (See N64-31098 22-08)

2. NONLINEAR ESTIMATION THEORY p 46–109 refs (See N64-31099 22-20)

N64-31098 University of Southern Calif. Engineering Center, Los Angeles

RESEARCH IN OPTICAL COHERENCE

In its Res. in Opt. Coherence and Nonlinear Estimation Theory Dec. 1963 p 1–45 refs (See N64-31097 22-08)

It is shown that the coherence properties of electromagnetic waves bear a direct relationship to their information-carrying capacity. Thus a maximum information transfer can only be accomplished by means of a coherent field. The coherence function is defined as a space-and-time averaged correlation function between field strengths at two points in a 4-dimensional space–time domain. The field is defined as "coherent" when the coherence function is a periodic function of an increment in the space–time coordinates. The field is defined as incoherent when the coherence function is zero. If the coherence function satisfies neither of these conditions, the field is "partially coherent." A number of examples are worked out of the coherence properties of monochromatic and polychromatic waves emitted by either point sources or extended objects. The effect of aperture limitation on the coherence properties of the image of the above sources is also investigated. Author

N64-31126 General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.

CW RADAR FOR MEASURING HEAD-ON RADAR CROSS SECTION OF FREE FLIGHT PROJECTILES. I: ANTENNA FOR SIMULTANEOUS 35 AND 70 Gc OPERATION

P. E. Robillard and W. E. Blore Jul. 1964 13 p refs
(Contract DA-04-495-ORD-3567(Z); ARPA Order 357-63; Proj. Defender)
(CTN64-01; AD-444070)

A multiplex antenna was designed for the 35-Gc and 70-Gc radars to be used in determining the radar cross sections. To operate two radars simultaneously, the two radar beams must be coaxial. Therefore, an antenna system was devised that would orient two cw beams coaxially with a minimum of interaction between the two systems. Operation of the two radars and the amount of interaction observed are discussed. P.V.E.

N64-31139 Philco Corp., Palo Alto, Calif. Western Development Labs.

SPECIAL PARAMETER TRACKING SIMULATION STUDY, LOW ALTITUDE SATELLITE, VOLUME IV

22 Apr. 1963 141 p
(Contract AF 04(695)-278)
(WDL-TR-1943, Vol. IV; AD-402218)

This report presents results in satellite position and velocity accuracy as a function of tracking data, number of passes, station latitude separation, and other pertinent variables in graphical form. The information was obtained by using the Co-Variance (Fixed-Bias) Simulator Program and a detailed list of tradeoff parameters. The report is to be used as a design tradeoff handbook for error propagation in orbit determination and includes tracked passes made through 120°, 90°, and 60° of azimuth. Author

N64-31155 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.

ANTENNA-COUPLING CONSIDERATIONS FOR A RECONNAISSANCE SATELLITE Technical Memorandum

Vernon C. Sundberg 15 Apr. 1963 35 p refs
(Contract DA-36-039-AMC-00088(E))
(EDL-M403; AD-420031)

This report presents the results of a study on the probability of detecting signals from a missile by a reconnaissance satellite. The signals from the missile are assumed to be fixed in frequency, continuous, and linearly polarized. The missile may be oriented vertically on the ground or may be in flight at an angle of 60° to the local vertical. The satellite continuously monitors the signal, and may employ either a linearly polarized or a circularly polarized antenna. The probability of signal detection is determined as a function of the satellite's receiver sensitivity, its antenna polarization, and the orientation of the missile. It is shown that, in most cases, a receiver using a circularly polarized antenna requires less sensitivity than a receiver using a linearly polarized antenna for the same probability of signal detection. Author

N64-31183 Illinois U., Urbana Radiolocation Research Lab.

A METHOD OF RADIOLOCATION EMPLOYING AROUND-THE-WORLD HIGH FREQUENCY PROPAGATION Technical Report 19

Roger S. Bredek Aug. 1963 48 p refs
(Contract Nonr-1834(02))
(RRL-214; AD-420668)

A method of radiolocation is discussed that permits obtaining a "fix" from measurements made at a single receiving station. The great circle distance between the transmitter and receiver is determined from the time delay between the signal transmitted via the short path to the receiver and the signal transmitted via the long path (around-the-world) to the receiver. The bearing of the signal is obtained by a Wullenweber-type radio direction finder. Results of an experiment in which signals transmitted from Stanford, California to Champaign, Illinois were studied showed that the great circle distance could be determined within 25 k. The transverse distance was determined within about 50 k. Author

N64-31187 Cornell U., Ithaca, N.Y. School of Electrical Engineering

CHARACTERIZATION OF TIME-VARYING LINEAR SYSTEMS Technical Report No. 76

A. Gersho Feb. 1963 181 p refs
(Contract DA-36-039-SC-85272)
(EE-559; AD-420573)

A versatile description of time-varying linear systems is achieved by the use of a family of eight system functions that includes the *G* and *H* transfer functions. This approach is extended to multidimensional systems and to "vector-time" systems operating on signals that are specified by a function of several variables. The class of time-varying linear systems that is specified implicitly by a set of *n*th order linear differential equations in *r* variables is considered. The same basic approach for characterizing deterministic systems leads to procedures for the characterization of randomly varying systems subjected to random inputs. It is shown that the time covariances and frequency covariances of the output can be related to the time and frequency covariances of the input by means of a two-dimensional Fourier transformation. Some properties of time-varying linear systems are developed, including stability, systems transformations, and magnitude-phase relations for the transfer functions. The characterization procedure is shown to be applicable to the study of doppler phenomena, ambiguity functions, optical filters, bandlimited interpolation, and random channels. Author

N64-31190 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Instrumentation Dept.

A METHOD FOR PREDICTING APPARENT ELEVATION ANGLE FOR A TROPOSPHERIC TARGET FROM SPECIFIED VALUES OF GEOMETRICAL ELEVATION ANGLE AND HEIGHT

Paul Milnarich, Jr. Oct. 1963 18 p refs
(ERDA-67; AD-422333)

A method is presented for calculating the apparent elevation angle to be expected for a tropospheric target for specified values of geometrical elevation angle and height. The assumptions are made that the troposphere is horizontally homogeneous and that the index of refraction decreases monotonically with height above a spherical earth. The method, which was devised as a tool for tracking system error analysis, allows for a direct prediction of apparent elevation angle for a given target position and for a direct application of the ray-trace formula for computing the corresponding radio range. Author

N64-31196 Radiation, Inc., Melbourne, Fla. Advanced Communications Group

INVESTIGATION OF CHAFF COMMUNICATIONS AT 5,000 MCPS Final Report, 1 Dec. 1962–31 May 1963

L. H. Bauer, C. J. Palermo, and B. L. Lewis [1963] 167 p refs
(Contract DA-36-039-AMC-00045(E))
(AD-420192)

An experimental and theoretical program was carried out to investigate the use of chaff for communication beyond the line-of-sight. The objectives of this program were to formulate a test plan and to specify equipment for collecting data over a two-terminal chaff communication system. The theoretical program included investigations of bistatic scattering cross section for chaff clouds, bandwidth and modulation effects, diversity performance, acquisition and tracking requirements, and optimum antenna sizes. In the experimental program, field tests were conducted at 5 Gc. The experimental system consisted of a 5.652-Gc transmitter and a 4-channel receiver. A radar was used for measuring the chaff cloud tracking angles, chaff cloud configuration, fall rate, and drift rate. A 10-lb chaff unit was dispensed over the receiver site by an aircraft.

Author

N64-31205* Freeman (J. J.) Associates, Inc., Silver Spring, Md.

REAL-TIME COMPENSATION FOR TROPOSPHERIC RADIO REFRACTIVE EFFECTS ON RANGE MEASUREMENTS

J. J. Freeman Washington, NASA, Oct. 1964 24 p refs
(Contract NAS5-1404)
(NASA-CR-109) OTS: $0.75

A formula for the tropospheric contribution to the electromagnetically measured range is evolved that depends on the measured value of the surface refractivity and on certain average site characteristics. The predictions of this formula were tested against 77 ray tracings of refractivity profiles measured with radiosondes at 13 different sites. The rms error in predicted compensation for tropospheric refraction effects on range measurements varied approximately from 1 m at a target elevation angle of 20 milliradians (approx. 1°) to 0.03 m at 90°.

Author

N64-31240 Denver Research Inst., Colo.

RESEARCH ON NEW TYPES OF ANTENNA SYSTEMS FOR THE FREQUENCY RANGE 50–1000 MC Final Report, 15 Jun. 1962–31 Aug. 1963

Warren R. Wheeler 20 Sep. 1963 88 p refs
(Contract NOw-62-0519-d)
(DRI-2118; AD-421044)

A study has been made of the way in which the horizontal pattern of a vertical dipole antenna changes when dielectric cylinders of square, rectangular, circular, and elliptical cross section are placed near the antenna. The results of this study are presented. Experimental patterns show only a bulging of the pattern opposite the cylinder, when the cylinder's largest cross section dimension is of the order of 0.1 to 0.25 wavelengths. For larger cylinders, the pattern breaks up into many lobes. However, in all cases studied, the maximum signal strength is usually in the direction of the greatest amount of dielectric between the antenna and the point of observation. The work of Rhodes, Wait, and Yeh on the theory of scattering has made possible the theoretical solution of the problem of an infinitely long line source near a dielectric cylinder of either circular or elliptical cross section. Several of these theoretical patterns are presented. Author

N64-31259 Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.

ESTIMATION OF BIAS ERRORS INDIGENOUS TO A SHIPBOARD RADAR TRACKING SYSTEM

R. D. Bachinsky Dec. 1962 74 p refs
(Contract DA-36-034-ORD-3144 RD)
(DAMP-TM-62-19; AD-421452)

This paper presents a method of statistically estimating and henceforth removing certain bias errors (systematic errors) from any sensor. Technical development is general, applicable to all measuring systems. The specific application discussed is a shipboard radar tracking system. It is shown that by estimating the bias errors in a shipboard system, as compared to a reference or standard, the shipboard tracking system can be made equivalent in accuracy to the reference. The selected reference may be a land-based radar, a land-based telemetry system, a star-track and ephemeris, or a satellite such as Transit. Simultaneous tracking by the shipboard radar and the reference system is not essential. Therefore, the shipboard tracking system may be remote from all other tracking sensors. The major source of bias errors indigenous to a shipboard tracking system that are to be estimated are inaccuracies in locating the ship and imperfect orientation of the ship deck or reference platform.

Author

N64-31260 Colorado U., Boulder

MODEL STUDY OF IONOSPHERE PERTURBATIONS AND PROPAGATION BETWEEN TWO SITES Quarterly Report No. 7, 1 Jul.–1 Oct. 1963

1 Oct. 1963 5 p
(ARPA Order 183-62; Contract NBS CST-7348)
(QR-7; AD-421962)

An improvement on the horn section was made by modifying the $\sin^2$ profile so that it would be plotted on a log-linear scale. The profile chosen for investigation was: $Y_A = 0.25$ in. + 4.55 in. $\sin^2 [\pi/18 (10^x - 1)]$, $0 < x < 1$. Subsequent measurements in the model waveguide when fed by this horn showed that the higher mode content was 3%, a substantial improvement. A major defect was uncovered, however, in that the perturbations in the waveguide reflected part of the incident energy back into the horn and these reflected waves were re-reflected into the model waveguide system as higher modes. This problem was reduced by placing a lossy dielectric slab across the model waveguide at the exit of the horn section.

A.W.

N64-31325 Army Signal Radio Propagation Agency, White Sands Missile Range, N. Mex. Frequency Management Activity

TELE-DYNAMICS MODEL 1062A VHF/FM TRANSMITTER SPECTRUM UTILIZATION CHARACTERISTICS

Quinnie M. Flint and John A. McGrane 13 Sep. 1963 30 p (FMA-TM-13-9-63-T; AD-421978)

Operational characteristics were examined empirically against the parameters of operating time, supply voltage, and temperature. Interference characteristics were also examined. The transmitter frequency tolerance remained within 0.003% of the assigned frequency; 0.01% is required. Ten narrow-band radiated signals exceeded the specification limits. All antenna-conducted spurious emanations met requirements; five emanations exceeded the limits. Deviation, resulting from a fixed modulation input voltage, increased 34% at −40° C. Author

N64-31327 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

THE LEAST SQUARES PROCEDURE APPLIED TO THE PROBLEM OF ESTIMATING MISSILE POSITION AND ATMOSPHERIC REFRACTIVE INDEX FROM DOVAP RANGE DATA

John E. White Jun. 1963 11 p refs (ERDA-43; AD-422247)

The general error model is presented and the DOVAP equations are then derived. The observed quantities are assumed to be the changes in loop ranges that are generated by missile motion with respect to a tracking system whose geometry is ellipsoidal. The model provides estimates of missile coordinates corrected for refraction error, the average index of refraction between tracking site elevation and the missile height, and the variances in these quantities. Author

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-30218 Joint Publications Research Service, Washington, D.C.

ON EVALUATION OF RANDOM BREAKDOWNS IN DIGITAL COMPUTERS

O. V. Shcherbakov *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 101–108 ref (See N64-30207 22-01) OTS: $6.00

It is shown that the flow of breakdowns in digital computers is simple. Experimental data are presented, along with graphs, which are necessary for the calculation of the rational process. Author

N64-30221 Joint Publications Research Service, Washington, D.C.

THE PROBABILITY CHARACTERISTICS OF ERROR IN AUTOMATIC CONTROL SYSTEMS WITH RANDOM PARAMETERS

A. I. Ressin *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 136–146 refs (See N64-30207 22-01) OTS: $6.00

Automatic control systems are investigated with one and with several inputs. The probability characteristics of error in a system with random parameters are established. The error characteristics are determined using the apparatus of stable and unstable random processes. Author

N64-30222 Joint Publications Research Service, Washington, D.C.

THE SYNTHESIS OF A TWO-DIMENSIONAL SERVOMECHANISM WHICH IS INVARIANT WITH RESPECT TO CHANGE IN SEVERAL PARAMETERS

P. F. Merabishvili *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 147–156 refs (See N64-30207 22-01) OTS: $6.00

Several problems are investigated in the synthesis of a transfer function of a two-dimensional servomechanism that is intended for reproduction. It is shown that in reproduction of curves several parameters in the system change values. Such a structure is chosen for the control system for which the quality of control depends little on the change in these parameters. Author

N64-30223 Joint Publications Research Service, Washington, D.C.

ON THE DETERMINATION OF OSCILLATORY PROCESS IN COMPLEX NON-LINEAR SYSTEMS FOR VARIOUS INITIAL DEVIATIONS

B. N. Petrov and M. V. Starikova *In its* Tech. Cybernetics No. 3, 1964 10 Sep. 1964 p 157–168 refs (See N64-30207 22-01) OTS: $6.00

A method is proposed for the determination of periodic solutions of complex nonlinear systems of an arbitrary order for various initial deviations. The method is based on harmonic linearization of nonlinearity and investigation of the space of characteristic coordinates X, jY, and amplitudes A. With this method it is significantly simpler than usual to find the stable, unstable, and semistable periodic solutions; that is, the critical expression of the parameters is found, the conditions of existence of auto-oscillations with a given amplitude and frequency and conditions for their absence are determined, and the conditions of stability of the system in general are found. Author

N64-30224 Joint Publications Research Service, Washington, D.C.

FREQUENCY AMPLITUDE TRANSFER FUNCTION OF A RELAY EXECUTIVE MECHANISM WITH SEQUENTIAL EXCITATION MOTOR

V. I. Tsvetkov *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 169–183 refs (See N64-30207 22-01) OTS: $6.00

In the present work, which is an extension of the solution of a nonlinear problem by the method of alignment with the use of harmonic linearization, a universal frequency amplitude transfer function is found for a relay executive mechanism, with a loaded sequential excitation motor. A change is considered in the differential equation of motion of the motor and its right side because of wearing and slackening of the relay and changes in the sign of the moment as a result of dry friction forces related to change in the sign of the velocity. Nonlinearity of the mechanical characteristic of the motor is approximated by means of a graph. Author

N64-30227 Joint Publications Research Service, Washington, D.C.

ON THE INVESTIGATION OF NON-LINEAR AUTOMATIC CONTROL SYSTEMS WITH AN EXTERNAL EFFECT

S. A. Chernikov *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 201–219 refs (See N64-30207 22-01) OTS: $6.00

Investigated are the auto-oscillations of mechanical transmitters between a motor and its load in the presence of external disturbances and the stability of automatic control systems with slack and other deformations. It is shown that in a number of cases auto-oscillations that arise in a system as a result of slack may be extinguished by means of premeditated

external effect on the system. Theoretical positions are illustrated in a concrete example of a nonlinear servomechanism and are compared with results of simulation of this system. Author

N64-30231 Joint Publications Research Service, Washington, D.C.
MAGNETIC COMMUTATORS OF LOW POWER LEVEL FOR DIGITAL SYSTEMS OF MULTIPLE CONTROL OF PRODUCTION PROCESSES
A. M. Khazen *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 261–271 refs (See N64-30207 22-01) OTS: $6.00

Presented are new principles of commutation and conversion of low-power signals from a transmitter of the thermocouple type or from a wire resistance tensometer, which do not require amplification of the signal in advance. As a commutator of input signals and simultaneous zero-organ of a conversion system for the input signal into a numerical code, special magnetic elements are used that are united into a matrix. The system of conversion, in spite of the low level of input power (the sensitivity threshold is 1μr for currents of less than one μa, is stable under external influences and maintains a total conversion error of no more than 0.2%. Author

N64-30457 Microwave Associates, Inc., Burlington, Mass.
KA-BAND CRYSTAL PROTECTOR Quarterly Progress Report, Mar. 15–Jun. 15, 1964
Paul Basken [1964] 21 p
(Contract DA-36-039-AMC-00157(E))
(QPR-5; AD-603161) OTS: $1.00

Life test results on two combination devices are presented. The first test includes a gas pre-TR, gas crystal protector, and solid-state PIN switch. Successful operation was achieved over a period of 1,122 hr. The second test consists of a gas TR tube and a PIN switch. It represents the finalized design, and accumulated over 1,400 hours without sign of failure. The merits of a gas pre-TR in conjunction with an efficient solid-state switch are discussed. The conclusion reached is that the pre-TR tube is not necessary if the gas fill of the TR tube is correspondingly adjusted. A new concept in dealing with diode parasitic reactances at very high frequencies is indicated. By taking advantage of these reactances, a vastly improved solid-state switch was developed. Test results on this switch are included. Author

N64-30506 Autonetics, Anaheim, Calif.
ANALYSIS OF LOG COMPRESSION AMPLIFIER
15 Aug. 1963 140 p Prepared for JPL
(Contract JPL-AV4-224494)
(NASA-CR-58820; EM-1063-7) OTS: $4.00 fs; $1.00 mf

The log compression amplifier circuit was analyzed by several different computer techniques. Each of these showed consistent results. In general, the circuit performs well under normal conditions. The fluctuations in the output currents, due to parameter tolerances and environmental changes, are quite large if the extreme worst-case conditions are assumed. Although these extreme conditions are not necessarily realistic assumptions, they do provide a bound on the output variables. The significant advantage of the computer techniques employed is that they pinpoint the parameters having the greatest effect on the output variables; that is, they provide a means of determining how sensitive the currents are to changes in specific component parameters. Throughout each of these analyses, the a.c. gain of the transistors h_{fe} was the most significant parameter affecting the output currents. If it is desirable to maintain more stringent bounds on the output currents, a transistor with a tighter tolerance on the h_{fe} should be selected. The d.c. analysis indicated that the transistor bias was satisfactory, even under extreme conditions. A detailed description of one of the computer routines (MANDEX worst-case) is included in the appendix. I.v.L.

N64-30522* Bendix Corp., Holmdel, N.J. Bendix Semiconductor Div.
DESIGN AND DEVELOPMENT OF A TEN NANOSECOND SEMICONDUCTOR SWITCH First Quarterly Progress Report
R. Reber and C. Carroll [1964] 52 p
(Contract NAS8-11611)
(NASA-CR-58794) OTS: $3.00 fs; $0.50 mf

The scope of this work involves the design, development, fabrication, and delivery of 5 prototype and 50 production semiconductor switches capable of extending the speed of high-level switching transistors into the low nanosecond range. Phase I, with which this report is concerned, consists of the essential study and the preparation of a complete design of the units. This phase has been completed in all major details. The principal areas of this phase include the following: (1) the determination of epitaxial starting-material specifications; (2) the design of surface geometry; (3) the determination of concentrations and depths of diffused regions; and (4) package design. I.v.L.

N64-30552 Bendix Corp., Davenport, Iowa Pioneer-Central Div.
FREQUENCY TEMPERATURE COMPENSATION TECHNIQUES FOR QUARTZ CRYSTAL OSCILLATORS Third Quarterly Report, 1 Jan.–31 Mar. 1964
R. H. Bangert 10 Jun. 1964 31 p
(Contract DA-36-039-AMC-02282(E))
(Publ.-3032-64; AD-444525)

The problems of designing a standardized network, the proposed solutions, and the conclusions are presented. These problems are divided into the areas of thermistor networks and crystal characteristics. The results of research into the method of defining allowable tolerances on the major components are given. Author

N64-30571 Microwave Associates, Inc., Burlington, Mass.
MINIATURIZED X-BAND STRIPLINE DUPLEXER Quarterly Progress Report, 1 Jan.–31 Mar. 1964
James W. Christian and Robert H. Brunton, III [1964] 31 p
(Contract DA-36-039-AMC-03230(E))
(QPR-3; AD-602757)

A prototype design of a 3-port stripline circulator is presented. Low loss performance was achieved over a 400-mc band centered at 9,450 mc. The design of a quadrature stripline 3-db hybrid is discussed. Isolation in excess of 18 db was obtained over a 500-mc band; however, the power split was excessive at the high end of the band. An insertion loss of 0.2 db was obtained on this preliminary unit. A number of diode limiter configurations are presented. By varying the electrical spacing between the two diodes and by adjusting the diode stub impedance, insertion loss values ranging from 0.8 to 1.4 db can be obtained on low level, with 33- to 45-db isolation obtained under forward bias. Author

N64-30574 Microwave Associates, Inc., Burlington, Mass.
INVESTIGATION OF HIGH POWER GASEOUS ELECTRONICS Sixth Quarterly Progress Report, 16 Feb.–15 May 1964
H. S. Maddix and J. Gregory [1964] 38 p refs
(Contract DA-36-039-AMC-00097(E))
(Rept.-6; AD-602724)

Equations expressing tube life as a function of initial square root cleanup rate have been derived. Validity of these equations

has been demonstrated by application ot actual life test data. The use of thin metallic films to control gas cleanup in quartz tubes has been investigated. Preliminary results with argon at room temperature indicate that an order-of-magnitude reduction in square root cleanup rate can be achieved by using a thin tungsten film as a diffusion barrier. Tungsten film erosion by the discharge was inhibited by the use of a second thin film of either tungsten oxide or silicon dioxide. Data obtained for the sorption of hydrogen in OFHC copper indicate that hydrogen diffuses into the metal bulk at a rapid rate compared with the observed rates for inert gases in quartz. Hydrogen was found to have an activation energy of 5.7 K cal/mole for diffusion in OFHC copper. Author

N64-30612* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF A FREQUENCY TRACKING SQUARE WAVE OSCILLATOR
R. W. Gunderson Washington, NASA, Sep. 1964 22 p refs (NASA-TR-R-208) OTS: $0.75

Presented is an analysis of the lockon oscillator used as an element in the adaptive tracking notch (ATN) filter. The analysis is accomplished by studying the phase space behavior of the variables describing operation of the system, and permits expressions to be developed through which important properties of the oscillator may be predicted. Examples are given, and results of a theoretical study are compared with results obtained from a breadboard mechanization of the system. Author

N64-30626 Illinois U., Urbana Coordinated Science Lab.
CONTROL OF CO-OPERATIVE SYSTEMS: THE RENDEZVOUS PROBLEMS
Darrell L. Gieseking Jul. 1964 56 p refs
(Contract DA-28-043-AMC-00073(E))
(R-218; AD-603015) OTS: $3.00

A study of optimal rendezvous strategies for cooperative controlled systems is presented. By rendezvous, it is meant that the systems approach each other in such a way that the system's velocities and accelerations are the same when the positions become the same. A solution to the single-input problem, using the calculus of variations, is given when the performance index is the integrated-square-error plus weighted control. By rewriting the problem in terms of the error coordinates, the rendezvous conditions are replaced by the stability conditions on the Euler–Poisson equations. The stable trajectories are found by factoring the coefficient matrix of the transformed Euler–Poisson equations. By using the stable trajectories, it is possible to express the optimal control laws in terms of the states of the systems. A solution to the multi-input problem, using Pontryagin's Maximum Principle, is given for the same performance index. Author

N64-30630 Phillips Pretroleum Co., Idaho Falls, Idaho Atomic Energy Div.
AN EIGHT INPUT ADAPTER FOR A CN-1024/211 TIME OF FLIGHT ANALYZER
R. I. Little and E. P. Elkins Jul. 1964 30 p refs
(Contract AT(10-1)-205)
(IDO-16953) OTS: $0.75

A CN-1024/211 time-of-flight analyzer was modified for instantaneous external memory control and external variable initial delay using the internal clock source. An external system was designed and constructed. This unit allows splitting the 1024 channel memory into 1, 2, 4, or 8 sections for use with a like number of separate inputs, in addition to some other interesting possibilities. It also contains an initial delay circuit, which uses the analyzer's clock for generating up to 65,504 channels of delay in increments of 32 channels. The external circuitry is also applicable to most other analyzer plug-ins and to the older CN-110 analyzer. Author

N64-30636 Atomic Energy Commision, Washington, D.C. Div. of Technical Information
ELECTRONIC AND SPECTROMETRIC NUCLEAR RESEARCH
L. S. Gorn, I. S. Krasheninnikov, and B. I. Khazanov Sep. 1964 292 p refs Transl. into ENGLISH from "Elektronika v Spektrometrii Yadernykh Izluchenii" Moscow, State Publ. House of Lit., Atomic Sci. and Tekhnol., 1963
(AEC-TR-6439) OTS: $3.50

Information that has been accumulated by the authors in working with electron-physics apparatus intended for the spectrometry of nuclear radiation is summarized. The summary is divided into the following groups: (1) spectrometric radiation detectors; (2) tasks of analyzing apparatus and their structures; (3) amplification of pulses; (4) amplitude discriminators; (5) single-channel pulse-height analyzer; (6) multichannel analyzers; (7) coincidence method in spectrometry; (8) output units of analyzers; (9) power supplies for spectrometric transmitters; and (10) measurement of the principal parameters of spectrometric apparatus. P.V.E.

N64-30643 Bell Telephone Labs., Inc., New York, N.Y.
ENGINEERING SERVICES ON TRANSISTORS Final Report, 1 Apr. 1960–31 Dec. 1963
S. R. Arnold, J. Kocsis, E. C. Mener, R. L. Pritchett, and K. D. Smith 28 Apr. 1964 105 p refs
(Contract DA-36-039-SC-90759)
(Rept.-15; AD-602746) OTS: $3.00

Included are the following: (1) general discussion of the high-frequency-transistor development project; (2) design theory for high-frequency germanium power transistors of conventional mesa structure, and for planar interdigitated structures; (3) discussion of developments in planar photoengraved microwave-power-transistor technology, with a specific fabrication sequence; (4) fabrication technology for an improved coaxial power header designed for microwave transistors; (5) presentation of high-frequency measurements on representative development model transistors with a 1-gc RF output up to 370 mw; and (6) overall summary of work. Significant technical progress has been made in planar fabrication technology, high-frequency header design, low-resistance electrical contacts, and power-transistor-design theory. Author

N64-30645 ITT Industrial Labs., Fort Wayne, Ind.
RESEARCH AND DEVELOPMENT TO IMPROVE THE RESOLUTION OF LATRON DIRECT VIEW STORAGE TUBES, PHASE II Interim Development Report, Mar. 2–Jun. 2, 1964
R. W. Hunter 2 Jul. 1964 10 p
(Contract NObsr-87264) OTS: $1.00

The experimental tubes were designed to evaluate the effect of the collector- and backing-screen mesh number on resolution. Resolution was measured for each of the four collector meshes. Microscopic examination of the scanned writing beam on the phosphor shows the 250 mesh is undesirable as a collector. High-resolution direct-view storage tubes require finer than 250-mesh collector screens. A.W.

N64-30648 Lincoln Lab., Mass. Inst. of Tech., Lexington
MULTISEGMENT DEPRESSED-COLLECTOR FOR HIGH-POWER KLYSTRONS Group Report 1964–34
A. Saharian 16 Jun. 1964 84 p refs
(Contract AF 19(628)-500; ARPA Order 85)
(ESD-TDR-64-339; AD-442958)

This report includes a survey of the literature on depressed collector technology for electron beam tubes and a description of an experimental investigation of biased collector operation on a megawatt level klystron. This investigation used a multi-segment collector designed to offer considerable flexibility in the electrical potential distribution in the collector. The problems associated with a biased collector are discussed, particularly the difficulties of voltage holdoff in the presence of high electron flux. Data are presented on the spent beam current and power distributions in the collector and the possible improvement in overall tube efficiency for various potential distributions and varying value of maximum retarding potential. It is observed, for example, that one could increase the total efficiency from 30% (at zero bias) to over 55% at a maximum bias magnitude about 0.8 times the original accelerating potential. Author

N64-30668 SFD Labs., Inc., Union, N.J.
DEVELOPMENT OF AN X-BAND CW CROSSED-FIELD AMPLIFIER Fourth Interim Development Report, 31 Mar.–30 Jun. 1964
M. Arnum Jul. 1964 17 p
(Contract NObsr-89503)
(SFD-33-IDR-4; AD-602924) OTS: $1.00

Reactively loaded interdigital line slow wave structures, both choke and crown supported, have been evaluated at cold test. Emphasis has been placed on obtaining an acceptable circuit impedance match across the desired frequency band. Several circuit impedance matching methods were investigated. Construction of two tubes incorporating such slow wave structures for hot test evaluation have been completed, and others are in progress. Performance evaluation of these tubes is now being conducted. Author

N64-30677 Lincoln Lab., Mass. Inst. of Tech., Lexington
FIELD EMISSION IN VACUUM VOLTAGE BREAKDOWN
G. E. Vibrans 8 May 1964 37 p refs
(Contract AF 19(628)-500)
(TR-353; AD-602844) OTS: $2.00

Field intensification and emitting area are determined for a spheroid and a whisker-shaped protrusion. The effects of an inhomogeneous field around a protrusion on the transmission coefficient for field emission are computed, and examples are given. The resistive heating of an emitter is analyzed for a case in which both the resistivity and the emission are temperature dependent. An instability is pointed out, and the external resistance that stabilizes the emission of a whisker is given. The spreading of the emitted beam due to field distortion at the protrusion and to space-charge repulsion is computed separately and given in general form. It is concluded that the beam spreads faster than previous hypotheses assume. The formation of small craters at the anode by single electron beams is questioned. Author

N64-30680 Boeing Co., Seattle, Wash. Aero-Space Div.
DATA BOOK FOR CIRCUIT ANALYSIS AND DESIGN—TREE, VOLUME II Technical Documentary Report, Jun. 1963–Jun. 1964
R. S. Caldwell et al Kirtland AFB, N. Mex., AF Weapons Lab., Jul. 1964 193 p refs
(Contract AF 29(601)-6014)
(WL-TDR-64-60, Vol. II; AD-446742)

This volume presents detailed radiation response data for most types of electronic components and also presents the necessary radiation equivalent circuit information for making circuit response predictions. A description of the basic effects, the radiation equivalent circuit, procedures for measuring the required parameters, and a compilation of significant and valid experimentally determined design data, including some from other laboratories is presented for each component. Components considered are resistors, capacitors, diodes, transistors, silicon controlled rectifiers, transformers and chokes, vacuum tubes, and miscellaneous piece-parts. Author

N64-30697 Lincoln Lab., Mass. Inst. of Tech., Lexington
PHASE SHIFT BY PERIODIC LOADING OF WAVEGUIDE Group Report 1964-28
J. A. Kostriza 25 Jun. 1964 33 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-344; AD-603060) OTS: $2.00

Periodic loading of a transmission line is considered in terms of a discrete number of identical sections in cascade. For n sections there are $(n-1)$ discrete solutions, i.e., $(n-1)$ spacings each less than half wavelength, between identical susceptances, which produce input match. Formulas are given for locating these $(n-1)$ roots and for evaluating phase shifts. Some numerical examples are worked out. Author

N64-30700 Chalmers U. of Tech., Goteborg (Sweden) Research Lab. of Electronics
SMALL-SIGNAL NONLINEAR KLYSTRON WAVES Research Report No. 41
S. Olving and M. Fischer 1 Mar. 1964 29 p refs
(Contract AF 61(052)-594)
(RADC-TDR-64-367; TN-3; AD-603573)

The report deals with the nonlinear aspects of space-charge wave propagation along a velocity modulated, confined, solid electron beam of finite radial extension. The gridded modulation gap is infinitely short, and the beam is surrounded by an infinitely well-conducting concentric tunnel. Maxwell's field equations and the nonlinear equation of electron motion are solved with the spatial boundary values properly taken into account. The method of successive approximations is used, and the second-order a.c. beam current, which is of the second harmonic frequency, is explicitly expressed. The results are numerically interpreted by the use of a computer and presented in the form of second harmonic beam current versus axial distance graphs for a number of parameter combinations of practical interest. These results are compared with those obtained analytically for a disc-electron beam model. Author

N64-30704 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE WAVE PARAMETER THEORY AS A SIMPLE AID IN THE REALIZATION OF QUARTZ BAND FILTERS IN A BRANCH CIRCUIT
W. Poschenrieder 23 Jul. 1964 19 p refs Transl. into ENGLISH from Ntz-Nachr. tech. Z. (Brunswick), v. 12, no. 3, 1959 p 132–138
(FTD-TT-64-363/1+2; AD-446792)

Subjects discussed with respect to the utilization of quartz filters are these: (1) branch reactances and their typical frequencies in quartz-filter sections; (2) development of special wave impedance functions; (3) calculation of the cut-through frequency; (4) importance of cut-through frequency in the realization of quartz crystals; and (5) formulas for the circuit elements and the process of their derivation. The use of quartz sections is recommended in filters where separation spaces between the bandwidth and attenuation band amount to less than 2% of the frequency. P.V.E.

N64-30735 California U., Berkeley Electronics Research Lab.
CONSOLIDATED QUARTERLY PROGRESS REPORT NO. 13, FEBRUARY 16–MAY 15, 1964

D. J. Angelakos [1964] 142 p refs
(Grants NsG-354; GP-2203; AF-AFOSR-117-63; Contracts AF 33(615)-1045; Nonr-222(53) et al)
(AD-602949) OTS: $5.00

Research progress is reported in the following areas: bioelectronics, circuits, electron streams, plasmas, radiation and propagation, solid-state electronics, and systems. R.L.K.

N64-30747 General Time Corp., Stamford, Conn. Central Research Lab.
AN ELECTROMECHANICAL STEPPER; TYPE TWO Final Engineering Report, 8 Mar.–6 Jul. 1964
6 Jul. 1964 92 p
(Contract NObsr-89384)
(AD-602817) OTS: $3.00

This report covers the design, development, testing and fabrication activities on an electromechanical stepper. It states the purpose of the research and development work involved, and gives general as well as detailed factual data and measurement procedure. The report also includes project performance schedule charts, a summary of preceding efforts, and recommendations for future action. A number of test data sheets and drawings, referring to the different solenoid models, are included. Author

N64-30752 General Electric Co., Syracuse, N.Y. Electronics Lab.
TUNNEL DIODES FOR PHASED ARRAY RADAR Final Report, Jul. 10, 1963–Jul. 10, 1964
[1964] 114 p
(Contract NObsr-89328)
(AD-602771) OTS: $4.00

A discussion of the system requirements and of considerations for tunnel diodes and tunnel-diode circuits for phased-array radar is presented. Summaries and conclusions are given regarding the work performed and the results obtained in the device and circuit programs during the year. Detailed discussions of work for both programs in the final quarter are given. Recommendations for future work are offered. D.E.W.

N64-30774 Remington Rand Univac, St. Paul, Minn.
STUDY OF METHODS OF IMPROVING COMPUTER RELIABILITY Appendix E
Jul. 1964 29 p
(Contract AF 04(694)-433)
(EF-3765-5; AD-603120)

The purpose of this report is to document the study on methods of improving the reliability of aerospace computers. The study covers reliability from the mathematics of reliability through to circuit redundance and codes for error detection and correction. Author

N64-30788 Lewis (E.B.) Co., Inc., East Hartford, Conn.
REPORT TO THE QUARTZ CRYSTAL INTEGRATION COMMITTEE
5 May 1964 30 p
(Contract DA-36-039-SC-86737)
(AD-602840) OTS: $2.00

The initial design of resonators and the subsequent engineering development to remove unwanted modes are described. It is concluded that the CR-(XM-46)/U resonator can be fabricated to meet the specification of the Technical Requirement SCS-135, promulgated by the Electronics Command of the U.S. Army. However, allowances must be made for a measurement technique consistent with the difference between a resonator designed for oscillator application and a resonator designed as a passive element in a crystal filter. D.E.W.

N64-30814 Centre de Physique Electronique et Corpusculaire, Orsay (France)
GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS [OF] ELECTRONIC BEAMS Interim Technical Report No. 3, 1 Jan.–31 Mar. 1964
[1964] 27 p
(Contract AF 61(052)-715)
(WR-1213; RADC-TDR-64-351; AD-603183) OTS: $2.00

Extension of the state-of-the-art of O-type carcinotron oscillators to the generation of submillimeter waves down to 0.3 mm is discussed. This report is concerned with gun studies, improvement of operation of a previously constructed gun, fabrication and testing of tubes in the 0.4-mm range, improvement of test equipment, and construction of a 0.3-mm tube. P.V.E.

N64-30865 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
OPTIMAL MULTIPLICATIVE CONTROL
Ashok Bhojwani and Peter Dorato Jun. 1964 65 p refs
(Grant AF-AFOSR-453-63)
(PIBMRI-1210-64; AD-601536) OTS: $3.00

This study is concerned with the optimal control of systems with dynamics of the form $\dot{\underline{x}} = (\underline{A} + u\,\underline{B})\,\underline{x}$, where $\underline{x}$ represents the state of the system and u represents the control input variable. This type of control problem is referred to as multiplicative control, since the state $\underline{x}$ and the control variable u appear as a product. Two integral performance indices are considered: (1) $S = \int_0^T (\| \underline{x} \|^2 + \lambda u^2)\, dt$, with no constraints on u, and (2) $S = \int_0^T \| \underline{x} \|^2\, dt$, $| u | \leq 1$, in addition to a minimum time performance index. Pontryagin's maximum principle is used to derive the optimization equations for each of the above problems. The general theory is illustrated by various first- and second-order examples. A short discussion of the problem of stability and singular control is included. Author

N64-30867 Sperry Microwave Electronics Co., Clearwater, Fla.
HIGH POWER FAST FERRITE SWITCHES Interim Development Report, 27 Dec. 1963–27 Mar. 1964
Apr. 1964 25 p
(Contract NObsr-89428)
(IDR-3; AD-603502)

The C-band materials investigation has been virtually completed. The vertical slab geometry was judged unsatisfactory in C-band at 1 megawatt peak power. However, a horizontal slab ferrite geometry, utilizing a slab in each of the four corners of the waveguide, was found to provide a switching bandwidth greater than 10% with no evidence of subsidiary resonance at 1 megawatt. Tests of a modified C-band waveguide T-junction indicate that a 10% bandwidth can be obtained for the SPDT switch. The center frequency of the switch is a function of the distance from the T-junction to the abrupt transition to the SPST element. Additional switching data were taken with the S-band SPST switching element. Ferrite length was increased to approximately 8 inches to achieve the desired switching bandwidth. A test electromagnet was fabricated with a solid iron core. A "turnoff" time of 200 microseconds was observed. Author

N64-30925 General Precision, Inc., Tarrytown, N.Y.
A STUDY OF SYNTHESIS TECHNIQUES FOR OPTIMAL CONTROLLERS Technical Documentary Report, 24 Jan. 1962–28 Mar. 1963
B. Paiewonsky, P. Woodrow, F. Terkelsen, and J. Mc Intyre Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Jun. 1964 197 p refs Res. Performed by Aeron. Res. Associates of Princeton, Inc.
(Contract AF 33(657)-7781)
(ASD-TDR-63-239; AD-605455)

A review of the state of knowledge concerning synthesis of optimal controllers has been completed. The history of the problem is summarized, and an account of the mathematical formulation of optimal control problems is presented. The difficulties associated with solving two-point boundary-value problems are discussed. The techniques presently being used are described. These include direct integration of the differential equations, gradient methods, and methods based on optimal evolution. The problems treated are mostly deterministic; however, a section on stochastic optimal control presents a review of the literature and a critical discussion of the formulation of stochastic control problems. Methods for finding the minimum value of a function of many variables are reviewed. A computational study of a synthesis procedure due to Neustadt was undertaken to determine the computational feasibility of the method. Author

N64-30940 Massachusetts Inst. of Tech., Cambridge
ADVANCED NOMOGRAPHY. VOLUME II: NOMOGRAPHIC ELECTRONIC COMPUTATION
Douglas P. Adams Griffiss AFB, N.Y., RADC, Jun. 1964 226 p refs
(Contract AF 30(602)-2411)
(RADC-TDR-62-274, Vol. II; AD-605371)

An electronic computer (identified as NOEL I for Nomographic Electronic) was designed and constructed to perform nomographic computation. Throughout the effort the choice of hardware and system configuration was evaluated in terms of expected performance figures and system cost. The report describes many approaches taken and alludes to others that were not tried due to time and funding limitations. The results obtained indicate that the concept of electronic nomography is feasible and further work is outlined that will extend the range of applicability. Author

N64-30941 Rome Air Development Center, Griffiss AFB, N.Y. Techniques Branch
EXPERIMENTAL INVESTIGATION OF VOLTAGE-CURRENT CHARACTERISTICS OF XENON FLASHTUBES
Fred J. Demma Aug. 1964 18 p ref
(RADC-TDR-64-294; AD-605183)

The purpose of the experiments was to determine the form of the flashtube's dynamic resistance and its value during conduction. The data obtained are the basis for the development of impedance-matching circuitry (pulse-forming networks) in the energy discharge circuit to permit maximum energy transfer between energy source and the flashtube. This consideration is particularly important for the attainment of an optimum design for high-energy lasers. This investigation, although confined experimentally to helical flashtubes, also yielded results that apply to linear tubes. Author

N64-30942 Polytechnic Inst. of Brooklyn, Farmingdale, N.Y.
CASCADE SYNTHESIS OF PASSIVE n-PORTS
Dante C. Youla Griffiss AFB, N.Y., RADC, Aug. 1964 180 p refs
(Contract AF 30(602)-2868)
(RADC-TDR-64-332; AD-605264)

This report presents a theory of cascade synthesis for lumped, passive n-ports based on a generalization of Richards' theorem to the matrix case. It is first shown that there is a natural way to define the "zeros of transmission" of a rational, positive, real matrix Z(p) and that the number of such zeros equals precisely (Z), the McMillan degree of Z(p). By applying the generalized Richards, theorem at a zero of transmission, it is possible to induce a degree reduction in the terminating impedance matrix. If the degree reduction is restricted from the outset to equal, at most, one, two or four units, the process generates the 2n-port analogs of the Richards, type E, and Darlington 4-terminal A, B, C, and D sections. The synthesis procedure encompasses nonreciprocal as well as reciprocal networks; economic realizations are achieved for all the primitive reciprocal sections and most of the nonreciprocal ones. Author

N64-30959 Case Inst. of Tech., Cleveland, Ohio
NETWORK SYNTHESIS THROUGH HYBRID MATRICES Scientific Report No. 4
R. J. Duffin, D. Hazony, and N. Morrison 18 Aug. 1964 47 p refs
(Contract AF 19(628)-1699); Grant DA-ARO(D)-31-124-G78)
(AFCRL-63-568; AD-605449)

It is shown that the hybrid matrices preserve the passivity property (PR), and that all combinatorially equivalent matrices have the same degree. (The degree measures the complexity of a network.) The invariants of combinatorially equivalent matrices form the main substance of this paper, and accompanying examples apply them to an n-port synthesis procedure. The work on this paper was motivated by the fact that, in one-port synthesis (the scalar case), j-axis zeros are as significant as j-axis poles. An n-port synthesis procedure was sought that avoided the tedious process of pole removal by matrix inversions and provided a method of removal of j-axis zeros directly. It is shown here that by use of hybrid matrices, n-port synthesis can be carried out in close analogy to the classical one-port synthesis procedure of Brune. Author

N64-30977 Chalmers U. of Tech., Goteborg (Sweden) Research Lab. of Electronics
PROPAGATION OF NONLINEAR HAHN-RAMO WAVES ALONG AN ANNULAR ELECTRON CURRENT SHEATH Research Report No. 40
S. Olving and O. Nilsson 1 Nov. 1963 39 p refs
(Contract AF 61(052)-594)
(TN-2; RADC-TDR-64-352; AD-603572)

This paper deals with a nonlinear theory of a velocity-modulated annular electron-current sheath of finite radius within a conducting concentric drift tube. Confined flow is assumed, and electron overtaking is forbidden. The linearized space charge waves are studied and compared with theoretical results concerning annular beams with finite thickness. The advantage of the current sheath model lies in the fact that it propagates a single space charge wave mode pair rather than an infinite set of such pairs, which radically simplifies the calculations. By the use of the method of successive approximations the theory is then extended into the nonlinear range, taking the radial boundary conditions and the initial values at the modulating gap properly into account. Author

N64-30982 Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
RESEARCH AND INVESTIGATION OF INVERSE EPITAXIAL UHF POWER TRANSISTORS Technical Documentary Report, Jul. 1963–Jun. 1964
A. Goetzberger and R. M. Scarlett Wright-Patterson AFB, Ohio, AF Avionics Lab., Sep. 1964 152 p refs
(Contract AF 33(657)-11403)
(AL-TDR-64-207; AD-605376)

This report describes development work toward a 10-w 500-Mc silicon npn epitaxial transistor. An extensive design theory permits calculation of important material and geometrical parameters to realize a given performance. Diffusion studies produced a greater understanding of the emitter dip effect, but lacked the control necessary for thin, heavily doped layers. Ion bombardment doping and epitaxial base growth are described. Devices were produced giving up to 7 w at 500 Mc

with 4-db gain. An important device principle, the shorted emitter, is described. Methods of evaluating contact resistance and designing control structures for diffusion evaluation are discussed. Author

N64-31013* General Electric Co., Syracuse, N.Y.
STUDY OF CAPACITORS FOR STATIC INVERTERS AND CONVERTERS Quarterly Report No. 4, May 16–Aug. 16, 1964
J. F. Scoville [1964] 51 p
(Contract NAS3-2788)
(NASA-CR-54185; RG3SCW-31-4) OTS: $3.00 fs; $0.50 mf

This study was initiated to obtain capacitor ac data and characteristics that are considered essential in the selection of static inverter and converter capacitors for space applications. This report covers the following: (1) capacitor dissipation factor and capacitance versus temperature and frequency; (2) comparison of metalized-paper polycarbonate-foil and metalized-polycarbonate capacitor dissipation factors; and (3) results of a 1000-hr capacitor life test with 400-cps voltage and 85° C ambient. Author

N64-31023 Joint Publications Research Service, Washington, D.C.
CIRCUIT WITH FERRITE FOR PRODUCING HIGH VOLTAGE NANOSECOND PULSES
R. B. Baksht and G. A. Mesyats 8 Oct. 1964 6 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (Moscow), no. 3, May–Jun. 1964 p 108–110
(JPRS-26780; TT-64-51037) OTS: $1.00

This is the description of a circuit for producing short pulses with amplitudes up to 20 kV by means of a nonlinear cell with ferrite anchor rings, which is connected to a cable through which the voltage pulse propagates. Data are cited on the effect of the propagating pulse parameters on the form and amplitude of the output signal. Author

N64-31025 Naval Civil Engineering Lab., Port Hueneme, Calif.
POWER SYSTEM TRANSIENTS AND A POWER TRANSIENT SIMULATOR
H. H. Kajihara 10 Jul. 1964 27 p refs
(N-621; AD-603420) OTS: $1.00

The results of the literature study on transients in power systems are presented. The methods currently available to protect against power parameter transitory excursions existent in raw commercial power are reviewed. Results of field measurements are presented. Preliminary operational specifications for a power transient simulator are outlined. Author

N64-31064 PASTORIZA Electronics, Inc., Boston, Mass.
A SPECTRUM ANALYZER USING DIGITAL STORAGE Scientific Report No. 1
David C. Freeman and Herbert E. Miller Dec. 1963 31 p
(Contract AF 19(628)-467)
(AFCRL-64-336; AD-600216) OTS: $2.00

A spectrum analyzer was built with 256 separate filters using a core storage scanned at a 7 msec rate. The most useful feature of the digital spectrum analyzer is that the system clock frequency determines the resonant frequencies of the 256 individual filters. Analysis of the digital integrator, first-order lag, and second-order filter shows that the center frequency Wn is $1/2\ T_D\sqrt{A}$ and Q is $\sqrt{A/2(A-2/3)}$. T_D is the time period at which a particular filter is sampled (also the time constant of the digital integrator) and A is the feedback factor in the digital first-order lag. Author

N64-31116 Litton Industries, San Carlos, Calif. Electron Tube Div.
HIGH PERVEANCE GUN STUDY Eleventh Quarterly Progress Report, 1 Dec. 1963–29 Feb. 1964
M. Hanley, A. Mizuharai, and F. Lee 28 Apr. 1964 27 p ref
(Contract DA-36-039-SC-87313)
(Rept.-11; AD-447439)

This report describes progress on the design and construction of a large inverted magnetron injection gun for a high-perveance klystron. The investigation of magnetic fields for the gun was completed, and an approximate relationship of axial field strength to direction of flux lines was derived. An electrical gun design was developed and placed on the resistor network for confirmation and refinement. The results were sufficiently satisfactory to warrant construction of the gun. Cold-test work was completed on the output cavity and two of the intermediate cavities of the klystron. The six-cavity design has been modified to a seven-cavity design. Author

N64-31125 Advance Technology Corp., Timonium, Md.
DIODE, MILLIMETER WAVE TYPE MIXER (3.2 MM) Fourth Quarterly Progress Report, 1 Mar.–31 May 1964
R. J. Bauer 30 Jun. 1964 44 p refs
(Contract DA-36-039-AMC-02347(E))
(Rept.-4; AD-447083)

An analysis is presented in which the low-frequency optimum values of barrier and i.f. resistance were determined for minimum conversion loss. The effects of the diode's parasitic elements on conversion loss are considered. Data are presented on the theoretical millimeter wave conversion loss, which agrees favorably with the best experimental result to date. Conversion loss results on several diodes using a new mount configuration are described. Results on the effects of temperature on gallium arsenide mixers are presented. A preliminary effort is outlined for fabricating mica windows to seal the waveguide diode mount. Conversion loss results on several Schottky-barrier diodes using p-type silicon are also described. Author

N64-31138 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
CAPACITIVE PROPERTIES OF THIN FILM DEVICES
Richard Mack Rowland (M.S. Thesis) Aug. 1963 102 p refs
(GE/EE/63-23; AD-419995)

Experimentation on the current transfer characteristics of very thin insulating layers has been reported. In this investigation a special bridge circuit is used to measure the capacitive properties of evaporated and sputtered thin-film diodes. The low-voltage limitations and nonlinear properties of the devices were considered in the instrumentation design. The measurements indicated a strong dependence of capacitance on frequency between 1 cps and 100 kc/sec. An increase in capacitance with dc bias was noted, but only small random variations with changes of signal amplitude. The devices were unstable and changed with both time and dc current. Author

N64-31151 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
A CROSSED GRID DISPLAY ELEMENT UTILIZING NONLINEAR RESISTIVE, PHOTOCONDUCTIVE, AND ELECTROLUMINESCENT LAYERS
Wilfred Frater Buckelew, Jr. (M.S. Thesis) Aug. 1963 100 p refs
(GE/EE/63-2; AD-420686)

The operating characteristics of a display element containing nonlinear resistive, photoconductive, and electroluminescent components were investigated. A number of small EL cells, PCs, and an NLR (simulated with a neon lamp-resistor circuit) were used to observe the characteristics of series combinations of NLR-EL-PC components with light feedback from the EL to the PC. Addition of the NLR to the EL-PC element increased the turn-on and turn-off voltages of the bistable characteristic. This allows the element to be operated at higher brightness levels, while reducing the possibility of accidental triggering. Author

N64-31152 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
A STUDY OF THE BORESIGHT ERROR IN THE MICROWAVE NETWORK OF VARIOUS MONOPULSE GUIDANCE RADAR SYSTEMS
Charles George Mc Lean (M.S. Thesis) Aug. 1963 60 p refs
(GE/EE/63-18; AD-420020)

A theoretical analysis of an amplitude comparison monopulse radar system utilizing 4- and 12-horn feed assemblies was made in terms of the boresight error. The method used for the development of the boresight error equations was the scattering matrix technique of cascading microwave components. This was extended to include unequal coupling in the output arms of the side-outlet magic tees and the side-wall short-slot quadrature hybrids. The boresight error for the 12-horn feed was shown to depend not only on the coupling coefficients, but also on the ratios of the signals on different pairs of horns. Author

N64-31163 Emmanuel Coll., Boston, Mass. Research Language Center
THE "CUT AND TRY" METHOD FOR SOLVING COMPLICATED NON-LINEAR NETWORKS WITH CONSTANT FLUX
Yu Chuei-Pang Bedford, Mass., AFCRL, May 1963 47 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 15, no. 2, 1959 p 588–602
(Contract AF 19(604)-8505)
(E-T-Ch-63-2; AD-420433)

This paper is a review of recent progress in the "cut and try" method for solving complicated nonlinear networks with constant flux. The network-transform method suggested by P.A. Ionkin is extended and applied to nonlinear networks regardless of their complexity. In addition to the use of the method, there are also detailed discussions on the study of the optimum plan for solution of the problem. A comparison between the network-transform method and the method using Kirchoff's equations is given. Application of the superposition theorem to a "mixed network" (containing not only nonlinear elements but also the portion constructed by linear elements) is considered. Author

N64-31169 Emmanuel Coll., Boston, Mass. Research Language Center
A GENERAL METHOD FOR SOLVING COMPLICATED MAGNETIC CIRCUITS AND NON-LINEAR D-C CIRCUITS
Wang Shiang-Yawng Bedford, Mass., AFCRL, Apr. 1963 43 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 15, no 3, 1959 p 113–129
(Contract AF19(604)-8505)
(E-T-Ch-63-1; AD-420439)

Using both diagrammatic and cut-and-try methods in accordance with Kirchhoff's laws of magnetic circuits, solutions of a magnetic circuit with an arbitrary number of branches and current coils are discussed in detail. A combination of both methods can be used to solve a dc circuit with an arbitrary number of nonlinear elements. A detailed process for solving this problem is also discussed. A.W.

N64-31172 Lockheed Electronics Co., Plainfield, N.J.
STUDY OF MICROWAVE R-F PULSE COMPRESSION Final Technical Report, Period Ending 25 Sep. 1963
John G. Ferguson, Curtis W. Barrett, and Ernst E. Steinbrecher 25 Sep. 1963 127 p refs
(ARPA Order 296-62; Proj. Defender)
(AD-421982)

In studying the feasibility of using stripline all-pass networks to provide a wideband dispersive network for use in pulse-compression radar, work was concentrated on bandwidths of about 400 Mc centered at 3 Gc. The dispersive filter design was based on a synthesis technique using lumped-constant all-pass networks. The feasibility of building stripline analogs to lumped-constant all-pass networks has been demonstrated, as has cascading of the networks to form a linear delay filter. Time-bandwidth products as high as 20 were obtained experimentally. Modifications have since been pursued that should make compression ratios of more than 100 practicable. Author

N64-31179 California U., Berkeley Electronics Research Lab.
CONSOLIDATED QUARTERLY PROGRESS REPORT NO. 10
D. O. Pederson et al 15 Aug. 1963 123 p refs
(AD-420222)

The progress is reviewed of research projects being carried out in the following areas: circuits, computer theory and programing, electron streams and interactions, plasmas, radiation and propagation, solid-state electronics, and systems. P.V.E.

N64-31181 Electromagnetic Technology Corp., Palo Alto, Calif.
FREQUENCY CONVERTER UNITS FOR L-BAND, S-BAND, C-BAND AND X-BAND Interim Development Report, 1–30 Sep. 1963
15 Oct. 1963 15 p ref
(Contract NObsr-89536)
(IDR-3; AD-420429)

Impedance and VSWR measurements were made of various types of 1N53 crystal cartridges in a Sage holder. Values of VSWR in excess of 10:1 were observed in the band 0.5 to 11 Gc. Thus, if no impedance matching network were employed, the loss from 50-ohm transmission line due to mismatch alone would be in general at least 6 db. A design of the high-pass filter for the L-band converter using rectangular waveguide was built and tested. The precise tolerance required in the width of the waveguide was not maintained; as a result, the increase in attenuation with decrease in frequency was not as large as required. The VSWR of the device was good. The first model of the band-pass filter for the L-band converter was built and tested. Insertion loss was too high. Author

N64-31182 International Rectifier Corp., El Segundo, Calif.
HIGH VOLTAGE SILICON RECTIFIER STACKS, PRODUCTION ENGINEERING MEASURE Quarterly Progress Report, Mar. 25–Jun. 25, 1963
Arnold Conn and E. J. Diebold 24 Jun. 1961 21 p
(Contract DA-36-039-SC-85977)
(QPR-8; AD-421627)

Ten units were assembled and subjected to the first stages of preproduction testing. Efforts were made to arrange facilities for temperature storage, salt spray, and life testing. A vibration tester was procured for vibration testing of these units and is performing satisfactorily. Author

N64-31194 Radio Corp. of America, Lancaster, Pa. Industrial Tube and Semiconductor Div.
DESIGN, DEVELOP, AND EVALUATE A HIGH-POWER INTEGRAL CIRCUITED TETRODE FOR 215 MEGACYCLE OPERATION Quarterly Interim Technical Report, 1 Jul.–30 Sep. 1963
I. E. Martin and A. W. Bachman 31 Oct. 1963 18 p
(Contract NObsr-85371)
(QITR-6; AD-421183)

The second high-power tetrode, designated type A-2696 and with serial number F50001, was completed and successfully tested to the primary electrical specification. During these tests, the tube delivered 825 kw ±1 db power output over a 10% bandwidth with less than 25 kw of drive power. The tube was crated for shipment. The third tube was completed to the point of final closure, and it was ready to be exhausted. D.E.W.

N64-31200 Kuthe Labs., Inc., Newark, N.J. ITT Electron Tube Div.
PRODUCTION ENGINEERING MEASURE FOR A PHASE II SUPER POWER HYDROGEN THYRATRON TUBE Fifth Quarterly Progress Report, Mar. 7–Jun. 6, 1963
H. E. Krefft [1963] 24 p
(Contract DA-36-039-SC-85985)
(Rept.-5; AD-421039)

Two Phase II tubes were built and processed, and subassemblies for two more tubes were made. The principal objectives of this activity were aimed at obtaining more experience in the assembly and processing of the tube and more data on questions of reliability and reproducibility. For fields of application with lower anode heat numbers, an air-cooled modification was made, and two such tubes were operated successfully in modulators for a linear accelerator. Author

N64-31226 General Electric Co., Auburn, N.Y. Rectifier Components Dept.
THE RESEARCH AND DEVELOPMENT OF HIGH CURRENT AND HIGH VOLTAGE SILICON CONTROLLED RECTIFIERS Quarterly Progress Report, 1 Jul.–30 Sep. 1963
[1963] 14 p refs
(Contract NObsr-87648)
(QPR-5; AD-421898)

The fifth quarterly progress report for the research and development of high-current and high-voltage silicon controlled rectifiers covers work performed on Device C. Process optimization of voltage, current, and speed, and the approach to various problems concerning fabrication of Device C are discussed. Test data obtained on representative samples fabricated during this period of development are included. Author

N64-31231 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
HUMAN-BODY TEMPERATURE CONTROL OF A CRYSTAL OSCILLATOR
S. S. Schodowski Aug. 1963 12 p refs
(USAELRDL-TR-2380; AD-421453)

The use of the heat regulation properties of the human body to control the temperature of a quartz crystal oscillator, thereby eliminating the need for an oven, has been frequently suggested. This report describes a crystal oscillator especially designed for such use and presents results of tests. Although uncontrolled factors prevented repeatability of test data, results indicate that a frequency-temperature stability better than $\pm 2 \times 10^{-7}$ over the ambient temperature range of $-25°$ to $+45°$ C is feasible. Author

N64-31233 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio
AN INVESTIGATION OF ELECTROLUMINESCENT VIDEO DISPLAYS
Carlton John Peterson (M.S. Thesis) Aug. 1963 89 p ref
(GE/EE/63/22; AD-420967)

The design and fabrication of electroluminescent (EL) video displays require the consideration of such topics as the phenomenon of electroluminescence, the operation of coincident-scan EL panels, the dynamic intensity requirements of video displays, the continuous control of EL displays, the threshold and storage characteristics of EL control mechanisms, the characteristics of ferroelectric (FE) materials, the operation of FE transchargers, the operation of coincident transcharger arrays, and the design of solid-state EL-FE transcharger video displays. The experimental and theoretical analysis of these topics is used as a basis for determining the characteristics and feasibility of EL solid-state television receivers. Author

N64-31238 Radio Corp. of America, Somerville, N.J. Semiconductor and Materials Div.
RESEARCH AND DEVELOPMENT ON HIGH CURRENT TUNNEL DIODES Interim Development Report, 1 Jul.–30 Sep. 1963
[1963] 16 p
(Contract NObsr-87540)
(AD-421897)

Emphasis during this period, was placed on fabricating 20 germanium and gallium arsenide 300-ampere tunnel diodes. In an attempt to try and improve both efficiency and high-temperature capability in gallium arsenide diodes, various alloying dots were investigated. These investigations revealed that the present 60/40 tin–lead counterdopant provides the highest efficiencies thus far achieved. The investigations also indicate that satisfactory diodes may be fabricated by using higher melting point counterdopants. Author

N64-31245 Sperry Gyroscope Co., Great Neck, N.Y. Electronic Tube Div.
DEVELOPMENT OF AN ELECTRON BEAM DUPLEXER Quarterly Progress Report No. 1, 1 Mar.–31 May 1963
I. Itzkan and A. Roemer Jul. 1963 34 p
(Contract DA-36-039-AMC-02174(E))
(NA-8210-8352-1; AD-416288)

A functional description is given of the device under development. A brief discussion of the electron beam modes used and the requirements for broadbanding the coupling between the beam and circuit modes are discussed. Design considerations are given for S-band electron beam duplexers. Author

N64-31275 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio
DESIGN OF A PULSE WIDTH MODULATOR FOR USE IN SILICON INTEGRATED CIRCUITS
Alfred James Wall (M.S. Thesis) Aug. 1963 50 p refs
(GE/EE/63/27; AD-421032)

A pulse-width-modulator model is designed and constructed to demonstrate that such a modulation function can be realized within a 250- by 125- by 30-mil silicon integrated semiconductor structure. All discrete model components are chosen to be reproducible within the above integrated structure. Three active and seven passive components are used. The modulator utilizes trailing-edge modulation and samples a single audio input signal at 20 kc. For an unmodulated output pulse width of 25 μsec, a modulation index of 0.25 was obtained with an input signal amplitude of 90 mv. The nonlinearity of the modulator response was less than 5%. Author

N64-31294 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Labs. for Pure and Applied Sciences
HIGH-FREQUENCY, CABLE-DRIVING AMPLIFIER FOR SEVERE NOISE ENVIRONMENT. NUCLEAR PULSE PROPULSION CONCEPT
W. Simmons 16 Oct. 1963 10 p
(Contract AF 29(601)-6214)

The device described is the main amplifier portion of a piezoelectric pressure gage and associated electronics designed for use in a radiation environment near a nuclear source. Incorporated in the amplifier are a difference amplifier input and signal amplification to aid in attenuating induced noise and a special power transformer to aid in eliminating ground loops. Shown schematically are the difference and video amplifiers, the output stage and driver amplifier, and the amplifier power supply. R.L.K.

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-30303 Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
NONDESTRUCTIVE TEST OF CARBON BEDS FOR REACTOR CONTAINMENT APPLICATION Progress Report, Jan.–Mar. 1964
David R. Muhlbaier Aug. 1964 22 p refs
(Contract AT(07-2)-1)
(DP-910) OTS: $0.50

Development of a standardized, nondestructive, and more generally applicable test for installed carbon beds that are used in reactor containment facilities was started by the Savannah River Laboratory. Tests showed that the limitations imposed on air velocity and on H_2O content of the carbon by an earlier testing method were reduced significantly when "freons" with higher boiling points were substituted for "Freon-12." Author

N64-30334* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
THE NATION'S FIRST SPACE PORT
Kurt H. Debus *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 51–59 (See N64-30326 22-01) GPO: $1.50

The first space port will be located on Merritt Island at the Kennedy Space Center in Florida. More than 50 structures are being built. Launch complex 39 will allow Saturn V to be assembled and prepared for flight in the controlled environment of a Vertical Assembly Building; transported to the pad on a crawler-transporter; and fueled and launched, all without preliminary exposure and without tying up the entire launch complex and preventing rapid and successive launches. The VAB will accommodate 4 complete vehicles simultaneously. The key to the operation of this complex is the mobile launch umbilical tower that has a supporting platform 1/2 acre in size and 25 feet thick. The vehicle is assembled and transported on the LUT. Launch facilities for more powerful boosters are discussed. R.L.K.

N64-30346* National Aeronautics and Space Administration, Washington, D.C.
GOVERNMENT AND INDUSTRY
Robert C. Seamans, Jr. *In its* Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 197–205 (See N64-30326 22-01) GPO: $1.50

The three variables that are constantly considered in NASA's program management are performance, cost, and time. An effort is being made to improve contracting procedures and forms so that industry, as well, carefully weighs the effect of operations on all three of these factors. The ideal approach to a new NASA flight project is outlined. R.L.K.

N64-30347* National Aeronautics and Space Administration, Washington, D.C.
GOVERNMENT AND UNIVERSITIES
Homer E. Newell *In its* Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 207–211 (See N64-30326 22-01) GPO: $1.50

The relationship of NASA with universities includes sponsorship of such projects as multidisciplinary research, predoctoral training, and assistance in providing suitable laboratory facilities for space-oriented research. R.L.K.

N64-30403 Rensselear Polytechnic Inst., Troy, N.Y.
THE EFFECT OF SIMULATED HIGH FORWARD SPEED ON A TWO-DIMENSIONAL GROUND EFFECT SUPPORT
Anthony A. West *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 39 p refs (See N64-30401 22-02)

Preliminary tests have been conducted to investigate the feasibility of using ground effect supports to provide suspension and propulsion of a vehicle at high forward speeds. The effects of simulated high forward speeds on the lift and drag of a two-dimensional ground effect support are correlated through a forward-speed parameter, which is derived in this report. Author

N64-30411 Rensselaer Polytechnic Inst., Troy, N.Y.
PRELIMINARY DESIGN CONSIDERATIONS FOR A 3-FT DIAMETER TUBE TRANSPORT PILOT MODEL
Leo F. Gijsels *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 13 p refs (See N64-30401 22-02)

This report deals with the design of a pilot model of the tube transport system. The means of propulsion considered here is a jet engine, placed behind the vehicle, and acting as the driver of an ejector pump that sucks the air from ahead of the vehicle and transfers it to the rear. The paper only covers the selection of some of the basic parameters involved. Author

N64-30412 Rensselaer Polytechnic Inst., Troy, N.Y.
RECOMMENDATIONS FOR FUTURE WORK
Joseph V. Foa and Russell M. Lewis *In its* Res. on the Dyn. of a Vehicle in a Tube Jun. 1964 6 p (See N64-30401 22-02)

A tube-transport system would provide a mode of movement characterized by very high speed, a high level of inherent safety, and complete independence from atmospheric and surface conditions. The immediate benefit of such a system would be the provision of very high speed, all-weather, direct mass transit between distant cities and within large metropolitan areas. Recommendations for further work during the next 2 years are presented. The recommended program consists of the following: (1) engineering analyses and research aimed at the determination of quantitative information required for a study of the economic feasibility of the proposed system; (2) design of a 3-mile pilot model; and (3) a preliminary feasibility study of the

proposed system. The engineering analysis should deal with propulsion, transonic acceleration, and vehicular support and stability. P.V.E.

N64-30429 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
DEVELOPMENT OF CLOSED LOOP
R. Brown, W. J. Slator, W. Morrison, J. Davidson, K. Cass et al *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 14 p (See N64-30427 22-24) OTS: $6.00

Effort was devoted to commissioning the complete loop, at first without the main generator section, so as to prove the mechanical and thermal performance and a capability for extended operation at high temperature, and with extremely low impurity content in the helium. Quantitatively, one of the objectives was to operate the complete loop at steady-state gas temperatures of over 2,200° K for more than 1 hr with <10 ppm content in the helium of molecular gases other than hydrogen. A brief description of the main aspects of development is given. Author

N64-30430 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
HIGH TEMPERATURE GAS CIRCULATION
R. Brown, W. J. Slator, V. Brown, K. Cass, and J. Davidson *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 61 p (See N64-30427 22-24) OTS: $6.00

A number of high-temperature runs, using various heater-transfer duct-generator duct configurations are discussed. For each run, the mode of operation, the inspection results, and the modifications made before the next run are outlined. P.V.E.

N64-30431 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
POWER GENERATION
R. Brown, W. J. Slator, V. Brown, K. Cass, and J. Davidson *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 2 p (See N64-30427 22-24) OTS: $6.00

Using a 2-electrode recrystallized-alumina generator duct assembly (with operation at 2,200° K), a magnetic field of 1.2 torr was applied, but no signal was obtained from a valve voltmeter connected to the electrodes. It is suggested that this indicates an impedance in the channel that is high compared with that of the leads and voltmeter. Preparations for a cesium-seeded power-generation run were begun, with the objective of seeded operation at nozzle-inlet temperatures above 1,900° K. Extensive measurements of temperature, pressures, etc., were made on all runs to characterize the various loop components. P.V.E.

N64-30433 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
HIGH TEMPERATURE HEATER
R. Brown, W. J. Slator, K. Cass, V. Brown, and J. Davidson *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 7 p (See N64-30427 22-24) OTS: $6.00

The development of a high-temperature heater has resulted in a facility capable of continuously heating helium flows in the range 5 to 10 g/sec at 1 atm to temperatures approaching 2,500° K. A multipass axial–radial flow radiation-shield concept has been adopted, and it improves significantly the overall heat-transfer process of the heater. Control and reduction of high radiant-heat losses by more than 60% has been established by the use of an outer concentric thermal insulation pack (zirconia fiber and finely dispersed cellulose carbon) over the full length of the resistance element. Satisfactory vacuum-outgassing techniques have been established for the heater assembly. Gaseous impurity contamination from the graphite to the helium under high-temperature flow conditions is exceptionally low (< 50 ppm) and readily controllable by the helium-purification plant. P.V.E.

N64-30434 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
HELIUM PURIFICATION ON ANALYSIS
R. Brown, J. Davidson, W. Slator, and A. Bottom *In its* Magnetoplasmadyn. Power Generation Res. Programme Pt. I: MPD Closed Loop [1964] 5 p (See N64-30427 22-24) OTS: $6.00

A system for the purification of helium is described. The purification plant is designed for a 6-m^3/hr continuous flow of helium at 1 atm with maximum differential pressure across the circulator, and is designed to remove O_2, H_2O, H_2, CO_2, CO, and A. On entering the purification plant, helium is heated electrically to 625° K in catalyst beds to convert CO and H_2 to CO_2 and H_2O, respectively. The remaining impurities are absorbed in molecular-sieve beds held at liquid-nitrogen temperature. The plant is capable of continuous operation by the provision of parallel catalyst and molecular-sieve beds, enabling isolation and reactivation to be continuously reduced to undetectable levels at the purification-plant outlet. Analysis is carried out using Pye Argon Chromatograph modified to work with helium as a carrier gas. The sampling operation is manual and takes 3 minutes. P.V.E.

N64-30435 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
CESIUM INJECTION AND RECOVERY
R. Brown, W. J. Slator, T. Archbold, V. Brown, K. Cass et al *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 22 p (See N64-30427 22-24) OTS: $6.00

A constant back-pressure cesium-feed system, employing a hypodermic needle, was used successfully. Seed fractions of ~0.5at.% were maintained over periods of up to 30 sec with a total seeding of ~380 g. Two other systems based on the microfeed piston principle and employing a mechanical piston and a purified paraffin oil piston, respectively, are in the final stages of commissioning. Each has a cesium containment of 1 kg and is capable of metering cesium over a seed-fraction range of ≤ 2at.%. P.V.E.

N64-30436 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
GENERATOR DUCT
R. Brown *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 13 p (See N64-30427 22-24) OTS: $6.00

A simple recrystallized alumina two-electrode-pair rectangular test section (1.5 in. × 0.5 in.) was assembled in the MPD generator test-section loop. After two carefully controlled thermal cycles under loop conditions with helium alone, the duct was stripped and inspected. It appeared that the ceramic section had maintained a smooth gas channel during operation, but all four wall sections were severely fractured, with the main cause being mechanical stress. Minor cracks in the side walls were typical of thermal-stress patterns. The support and housing arrangement for the generator section, tantalum transfer duct, cesium injection, and supersonic nozzle was redesigned. P.V.E.

N64-30460 Atomic Energy of Canada Ltd., Chalk River, Ontario
AN INTENSE NEUTRON GENERATOR BASED ON A PROTON ACCELERATOR
G. A. Bartholomew, J. C. D. Milton, and E. W. Vogt Aug. 1964 114 p
(AECL-2059)

A study was made of the demand for a neutron facility with a thermal flux of $\geq 10^{16}$ n cm^{-2} sec^{-1}, and of possible methods of producing such fluxes with existing or presently developing technology. Consideration of the heat generated in the source per useful neutron liberated shows that the (p,xn) reaction with 400–1000 MeV bombarding energies and heavy-element targets, such as bismuth or lead, is capable of greater specific source strength than other possible methods realizable within the time scale. The study revealed that a facility delivering a proton beam of about 65 mA at about 1 BeV would satisfy the flux requirement, with a neutron cost significantly more favorable than that projected for a high-flux reactor. It is also suggested that a proton storage ring providing postacceleration pulsing of the proton beam should be developed for the facility. D.E.W.

N64-30477 National Aero- and Astronautical Research .nst., Amsterdam (Netherlands)
NLR, 1964
[1964] 30 p

The scope of the work carried out at the National Aeronautical and Astronautical Research Institute (NLR) is discussed, and some of the more important equipment used for testing is described. Included are discussions of the following: (1) facilities—plant sites, wind tunnels, etc; (2) wind-tunnel models and balances; (3) nonaeronautical application of wind tunnels; (4) testing of free-flight models; (5) theoretical and experimental flight mechanics; (6) aeroelasticity and vibration; (7) applied mathematics and data processing; (8) electronics designing offices; and (9) publications. P.V.E.

N64-30488 Portugal Nuclear Energy Commission, Sacavem Lab. de Fisica e Engenharia Nucleares
THE PORTUGUESE ONE MEGAWATT SWIMMING POOL RESEARCH REACTOR (RPI) Reactor Project and Preliminary Hazards Report
Carlos Cacho 1963 132 p
(LFEN-1 (β))

The reactor is a two-section pool and may operate in either of two positions in the pool. Irradiation facilities include a thermal column, several beam tubes, a dry irradiation chamber, and a gamma room. Described are the reactor components, pool, bridge and support structure, core, cooling system, control and instrumentation, experimental facilities, and shielding. The reactor building and support facilities are also described. Among the items discussed are fuel requirements, hazards, and reactor utilization. E.K.R.

N64-30501* Lockheed Missiles and Space Co., Sunnyvale, Calif.
RIFT DATA CENTER MANUAL Report No. 406
L. L. Woodward and H. F. Plank 6 Jan. 1964 48 p
(Contract NAS8-5600)
(NASA-CR-56778; NSP-64-01) OTS: $2.00 fs; $0.50 mf

The purposes of this manual are to assure compatibility of the RIFT Program Data Center with Government and associated contractor systems, and to set forth criteria for establishing, operating, and maintaining the system. The following types of information concerning the data-center system are presented: (1) methods proposed to develop and to maintain the system; (2) functional areas of responsibility for supplying technical and administrative data in support of the system; (3) methods of collecting, processing, and reporting data in support of the system; and (4) milestones in the evolution of the system. The master data system will be likely to consist of six data blanks, utilizing common language, and identified tentatively as follows: engineering, manufacturing, logistics and materials, quality, reliability, and test operations. I.v.L.

N64-30517* Martin Co., Baltimore, Md.
SATURN S-IC HIGH PRESSURE HELIUM STORAGE BOTTLES Final Design Report
R. A. Hirsch Jun. 1964 31 p refs
(Contract NAS8-5151)
(NASA-CR-58784; ER-13559) OTS: $2.00 fs; $0.50 mf

The evolution of the design is described. Summary information is presented on material properties, qualification-test results, and stress analyses. The design and fabrication processes were demonstrated to be adequate in all aspects. The inherent reliability exceeds the requirement that the probability of surviving the operational environment be 0.99994; the implication is that a smaller safety factor could be used that would permit a smaller wall thickness and decreased weight. R.L.K.

N64-30578 Bell Helicopter Co., Fort Worth, Tex.
CONTACT ANALOG SIMULATOR EVALUATION: CLIMB OUT, LOW CRUISE AND DESCENT MANEUVERS
J. H. Emery and D. J. Dougherty May 1964 60 p refs
(Contract Nonr-1670(00))
(D228-421-017; AD-603744)

This report summarizes work to evaluate a contact analog vertical display. The display is an electronically generated encoded representation of the real world, capable of presenting sensed information for altitude, airspeed, heading, pitch, and roll. Encoded ground-position and flight-path symbols were also capable of being generated. Pilot subjects performed simulated helicopter flight maneuvers, which included lift-off, climbout, cruise, and approach. The task was performed on different conditions of display content, glideslope angle, and heading. Measures of performance included absolute integrated error of climb and approach airspeed, glideslope angle deviation, maximum vertical deviation from glideslope, fore/aft and lateral position error at hover, and vertical speed and altitude at hover. Analyses of the results are presented and discussed. Author

N64-30615 Defence Research Chemical Labs., Ottawa (Canada)
FEASIBILITY STUDY OF PULSE SHAPING FOR THE SOLAR FURNACE
G. G. Drew Dec. 1963 25 p refs
(TN-63-23; AD-443254)

This paper deals with the basic characteristics necessary in a pulse at a target—the changes in intensity and spectral distribution with time. The changes required in the solar spectrum are detailed, and a possible mechanism for the shutter of the DRCL solar furnace for providing the required characteristics is suggested. Author

N64-30687 University of Southern Calif., Los Angeles
MAINTAINABILITY PREDICTION: METHOD AND RESULTS
Joseph W. Rigney Jun. 1964 128 p refs
(Contract Nonr-228(22))
(TR-40; AD-603241) OTS: $4.00

Maintainability prediction for electronic equipment is reviewed in terms of desirable attributes of maintainability criteria, utility as an important characteristic of prediction

methods, the major prediction schemes, practical criteria for selecting a procedure to use, and methodological weaknesses in current empirical methods. Six different approaches to maintainability prediction are reviewed. Important contributions of each of these methods are noted. Weaknesses of the different approaches are discussed. Author

N64-30723* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATOR STUDIES OF SPACE AND LUNAR LANDING TECHNIQUES
Byron M. Jaquet *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 144–166 refs
(See N64-30712 22-10)

Simulator studies pertinent to space flight and lunar operations are reviewed. Only studies involving man as the primary source of command are discussed. Included is a discussion of simulation equipment used for studies involving rendezvous, docking, lunar landing, and lunar self-locomotion. P.V.E.

N64-30731 Air Force Missile Development Center, Holloman AFB, N. Mex.
USE OF EXTRATERRESTRIAL RESOURCES FOR MARS BASING
Ernst A. Steinhoff *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 272–297 refs
(See N64-30712 22-16)

The results of this work show that if water can be found in the form of water of crystallization in rocks or in subsurface deposits in the form of permafrost, a very major portion of the total logistics requirements for permanent lunar and planetary bases can be supplied locally, particularly if LH_2 and LO_2 are used as the principal propellants for the return vehicles. The supporting technology to achieve this capability should be developed in parallel with the lunar transportation technology so as to make use of local resources as early as possible. While some of the components will have to be adapted for use on Mars, others will be directly applicable without further modification, and the design philosophy will be similar. While in many cases the names Moon and Phobos are eventually substitutable, the main target of this work is autarchic base operation on Mars and its satellites. Author

N64-30741 Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
MISSILE LAUNCHING ZONE FOR THE USS JOHN KING (DDG-3)
T. A. Trant and J. L. Lindsey 6 Jul. 1964 32 p refs
(NWL-1928; NAVWEPS-8340; AD-602834)

This report presents the factors considered in the computation and analysis required in the determination of the guided missile launching zone for the U.S.S. John King (DDG-3). The missile launching zone is defined, and a structural grid chart is given. The DDG-3 is a guided missile destroyer that employs a MARK 8 MOD 0 launcher in a MARK 11 MOD 0 launcher system. Author

N64-30804 California U., Berkeley Lawrence Radiation Lab.
THE 25-INCH LIQUID HYDROGEN BUBBLE CHAMBER
F. Barrera, R. A. Byrns, G. J. Eckman, H. P. Hernandez, D. U. Norgren et al 25 May 1964 39 p refs
(Contract W-7405-ENG-48)
(UCRL-11384) OTS: $1.00

Unique to this chamber is a movable top window that serves both as the piston for the liquid-expansion system and as an optical condenser lens. The motion of this window is controlled by a single-convolution bellows welded into the chamber perimeter; use of such a bellows avoids frequency-response problems common with multiconvolution bellows. Due to the action of this top window, turbulence is virtually eliminated because no liquid either enters or leaves the chamber. The aspherized condenser lens system is approximately five to ten times more efficient than any installed in earlier machines of this size. There are fewer ghost reflections, more uniform bubble tracks, and greater simplicity of operation than before. A scattering angle of 12° improves photographic uniformity in depth and avoids the need for individual light sources for each stereo lens. Author

N64-30805 Oak Ridge National Lab., Tenn.
FIRE AND EXPLOSION PROTECTION OF GLOVE-BOX FACILITIES A Literature Search
Sidney F. Lanier, comp. Sep. 1964 57 p refs
(TID-3578) OTS: $3.00

A total of 379 references are cited on the safety design of facilities handling radioactive materials. Included are references on glove boxes, fire hazards and control, explosion hazards and control, laboratory design, ventilation systems, and filter systems. Author

N64-30806 Lockheed Missiles and Space Co., Sunnyvale, Calif.
INTEGRATED TEST PLAN GEMINI AGENA TARGET VEHICLE
E. D. Reamey 31 Jan. 1963 109 p
(Contract AF 04(695)-129)
(LMSC-A306106-B; SP-63-03; AD-448926)

Gemini Agena Target Vehicle tests described include the factory-to-launch sequence of testing, development and qualification testing, propulsion test-vehicle-assembly testing, aerospace ground-equipment requirements, Gemini Agena equipment list, and a proposed combined spacecraft–Target Docking Adapter–Agena RF and command compatibility test. M.P.G.

N64-30808 Kitt Peak National Observatory, Tucson, Ariz.
[ACTIVITIES OF THE STELLAR, SOLAR AND SPACE DIVISIONS AND PROGRESS ON THE CERRO TOLOLO INTER-AMERICAN OBSERVATORY] Monthly Report, Jul. 1964
[1964] 26 p Sponsored by NSF

Personnel, equipment, and operational data are reported for the Stellar, Solar, and Space Divisions of the Kitt Peak Observatory, and the logistics problems of setting up a situation for zodiacal light observations on a peak in the Bolivian Andes are enumerated. Abbreviated weather reports for July, 1964, at the Kitt Peak National Observatory and the Cerro Tololo Inter-American Observatory in Chile are included. M.P.G.

N64-30817 Suffield Experimental Station, Ralston, Alberta (Canada)
A FACILITY FOR DYNAMIC EXPOSURE OF TEST OBJECTS TO VAPORS AND AEROSOLS OF LOW-VAPOR-PRESSURE LIQUIDS
F. E. Owen and J. E. Mayhood 18 Oct. 1963 18 p refs
(TN-119)

A novel method has been developed for generating aerosol-free vapor concentrations of low vapor-pressure liquids in large flows of air. Application has been made to the construction of a turbulent-flow wind tunnel of $0.8m^2$ cross section for use in studies of the comparative collection efficiencies of skin and military clothing for vapor and for aerosol. Author

N64-30894 Vermont U., Burlington
THE DEVELOPMENT OF A SIMPLE SELF-CONTAINED AND REPRODUCIBLE STRAND TEST
John O. Outwater and Michael R. Yendrzeski 12 Jun. 1964 10 p
(Contract Nonr-3219(01) (X))
(TM-230; AD-601175) OTS: $0.50

A self-contained casting device has been developed to make strand tests with 10 units simultaneously cast under constant tension. They are all cured at the same temperature, and the ends of the strands are so contoured that they will fit into adapters in Instron jaws to give rapid and reproducible tensile results. This apparatus minimizes the role of the operator and reduces several of the variables associated with the present ASTM strand test. The standard deviation is less than 6%. Author

N64-30895 Human Factors Research, Inc., Los Angeles, Calif.
A STUDY OF SIMULATION REQUIREMENTS FOR SONAR OPERATOR TRAINERS
Robert R. Mackie and Albert Harabedian Mar. 1964 64 p refs
(Contract N61339-1320)
(NAVTRADEVCEN-1320-1; AD-603329)

In order to develop a generalized trainer for sonar operators, a study was made of the relative effectiveness of actual recorded target signals and of synthetic target signals of various degrees of realism. The results indicated that while training on simulated signals generally transfers positively to the operational situation, signal realism is a critical factor in most cases, with training on the fully realistic signals producing the highest level of performance. However, the relationship is not simple, e.g., signal realism was more important for training operators in target detection than in target tracking. Specific system-design recommendations for a generalized sonar-operator trainer are made; the use of highly realistic synthetic signals is advised because of the many training advantages they offer. R.L.K.

N64-30899 General Electric Co., Philadelphia, Pa. Missile and Space Div.
CONCEPTUAL DESIGN STUDY FOR INTEGRATED ORBITAL OPERATIONS SIMULATION FACILITY
Edwards AFB, Calif., AF Flight Test Center, Feb. 1964 170 p refs
(Contract AF 04(611)-9093)
(Rept.-64SD472; AD-446279)

This report presents the results of the integrated orbital operations simulation facility (IOOSF) in the following three parts: (1) the IOOSF design and performance characteristic requirements—facility requirements and moving-base design analysis; (2) the IOOSF design requirements for the preliminary and secondary building structures—building construction concepts and tradeoffs; and (3) the IOOSF cost estimates—development and operating costs. I.v.L.

N64-30979 Naval Ordnance Lab., White Oak, Md.
ALKALI METAL ARC TUNNEL Ballistics Research Report 129
H. H. Hoehn, D. Levine, and A. Garcia Aug. 1964 12 p
(NOLTR-64-82; AD-604845)

The design and operation of an aerodynamic wind tunnel that derives its working gas from the arc heating of liquid sodium are described. In particular, the problems of materials and the design of electrodes are discussed. Author

N64-30987 Rocketdyne, Canoga Park, Calif.
TOTAL IMPULSE MEASURING SYSTEM FOR SOLID-PROPELLANT ROCKET ENGINE Final Report
V. C. Plane Aug. 1964 129 p
(Contract AF 04(611)-8515)
(R-5638 RPL-TDR-64-110; AD-605491)

Among the phases of the program effort discussed are the following: (1) study of the thrust integration system; (2) new and original analyses of spring-mass systems; (3) mathematical analyses of a parallelogram compression-type engine suspension flexure system; (4) determination of specifications and performance requirements of all measurement system components consistent with the required overall system accuracy; (5) new and original design concepts and considerations of a remotely operated high-precision hydraulic calibrator; (6) the design of the solid propellant engine test stand; (7) fabrication, inspection, and testing of all critical components prior to system assembly to determine conformance with specifications; (8) construction of the test stand and alignment of critical components; (9) system tests and calibrations; and (10) statistical analyses of calibrations. Author

N64-31021 Tactical Air Command, Langley AFB, Va.
OPERATIONAL FEASIBILITY EVALUATION OF AIRCRAFT LAUNCH AND ARRESTED LANDING EQUIPMENT
Jun. 1964 20 p
(TAC-TR-63-71; AD-601785) OTS: $1.00

A limited short-term evaluation was made of aircraft launch catapults and aircraft rapid cycle arresting gear installed on an aluminum air field mat. The aircraft catapult as evaluated is unsuitable for use by USAF tactical forces. It is not compatible, when rigged for operation with operational arresting gear, has slow launch rates, has an undemonstrated reliability factor, and is not capable of launching the F-4 series aircraft at their maximum gross weights. The arresting gear operated in a satisfactory manner. Installation of this type or similar gear at USAF bases with heavy F-4C traffic appears feasible and worthwhile for recovery of aircraft during hazardous conditions. The AM2 aluminum runway mat is suitable for C-130 and F-4C operations provided it is installed on a good subgrade. Author

N64-31046 ARO, Inc., Arnold Air Force Station, Tenn.
FLOW VISUALIZATION TECHNIQUES FOR USE IN HYPERSONIC WIND TUNNELS
R. W. Rhudy Arnold Eng. Develop. Center, Oct. 1964 28 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-108; AD-448116)

Various methods of flow visualization have been an integral part of wind-tunnel testing for practically as long as such tests have been performed. Two such methods, oil flow and thermal (temperature-indicating) paint, as applied to Mach 8 and 10 continuous tunnels, are discussed. A method for obtaining oil flow information from the VKF 50-in. Mach 8 and 10 tunnels is outlined, along with the types of models used and the application of the information obtained. The procedure used to obtain the thermal paint information from the VKF hypersonic tunnels is also outlined. A method of obtaining quantitative as well as qualitative data and the type of models used are discussed. Author

N64-31049 Naval Ordnance Lab., White Oak, Md.
THE NOL 3 MEGAWATT RESEARCH ARC
E. M. Winkler, R. E. Lee, R. L. Humphrey, and L. J. Milner Oct. 1964 77 p refs
(Aerodynamics Res. Rept.-202; NOLTR-63-114; AD-448219)

The design and initial performance of a 3-mW electric-arc air heater are discussed. This arc will be used as a heat source in a true temperature wind tunnel designed, and currently under construction, for operation at Mach numbers between 3 and 12 at supply pressures of 5 to 150 atm and total energy levels up to 5300 Btu/lb. The arc heater operates on 3-phase ac. Its components, control systems, and instrumentation are described in detail. The initial performance studies were carried out using a Mach 3 nozzle with the flow expanding into the ambient atmosphere. These tests were carried out at supply pressures up to 45 atm. The highest gas energy level obtained was 7700 Btu/lb. Author

N64-31106 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROBLEMS OF MEDIUM-CALIBER ANTIAIRCRAFT ARTILLERY IN CONNECTION WITH ACTIVATED FUSES
Sava Glumicic 24 Aug. 1964 11 p Transl. into ENGLISH from Vojnotehnicki Glasnik (Yugoslavia), no. 6, 1963 p 449–453
(FTD-TT-64-166/1+2; AD-447336)

Problems involved in using antiaircraft artillery to destroy present-day aircraft are described. In particular, the types of fuses used in antiaircraft shells are discussed, and a comparison is made between delay and proximity fuses. P.V.E.

N64-31111 Battelle Memorial Inst., Columbus, Ohio
HYPERVELOCITY-PROJECTOR FACILITIES
J. L. Harp, D. N. Gideon, and R. A. Stein 30 Jun. 1964 216 p refs
(ARPA Order 197; Contract ARPA-SD-80)
(BAT-197-21-4; AD-443101)

Information on operational projectors is presented first in a brief chart containing the method of projection and designation of the projector, along with a representative projectile mass and velocity capability. Projectors included in this report have been restricted to those for which the projectile mass is appreciable; i.e., projectors of ions and electrons are excluded. For the most part, the velocity values given represent the maximum capability of the projector. The summary sheets following the chart give a brief description of the projector and the associated range, available instrumentation for measuring projectile velocity, mass, orientation, and impact phenomena, attainable vacuum at the target, size of target that can be accommodated, and projector operational date. Author

N64-31123 Little (Arthur D.) Inc., Cambridge, Mass.
ANTI-BLAST VALVE DEVELOPMENT, 1960–1964 Final Report
Sep. 1964 74 p
(Contract CDM-SR-61-78)
(C-63584; AD-447115)

The primary function of an antiblast valve is to protect the equipment and personnel of hardened installations against the effects of nuclear blast. The valves are placed in the intake or exhaust air ducts of the hardened installations where they may be closed by the actual blast or triggered closed by sensing pressure rise, heat rise, etc., caused by a nuclear explosion. Discussed is the development, in the form of a complete set of reproducible drawings, of a final design for a 16-in. antiblast valve that would meet specified requirements and be well adapted in all respects to its intended service (the protection of shelter ventilating systems). The redesigned valve is a poppet-type pressure-sensitive valve with a weather-hood protection that can be close coupled to the valve or remotely mounted. The valve is designed for mounting on standard pipe flanges and is suitable for either intake or exhaust service. Blast-valve field tests are also discussed. P.V.E.

N64-31137 ARO, Inc., Arnold Air Force Station, Tenn.
GENERAL DESCRIPTION AND PERFORMANCE OF THE PROPULSION ENGINE TEST CELL (J-2A)
J. R. Reeves, Jr. Arnold Eng. Develop. Center, Aug. 1964 62 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-138; AD-444326)

The propulsion engine test cell (J-2A) is unique in that it combines the capabilities of an ejector–diffuser and the rocket test facility exhaust machinery (with the capabilities of a high-vacuum chamber) into a high vacuum facility that is suitable for propulsion testing. Testing capability is extended into a higher vacuum range by the use of mechanical vacuum pumps, oil-diffusion pumps, and a gaseous helium cryogenic pump. This is the first facility of this type ever constructed for testing 20,000-lb-thrust chemical rockets with simulated space coast capability near 400,000-ft altitude and with ultrahigh altitude environment during rocket firing above 200,000 ft. A liquid-nitrogen-cooled liner forms the internal cell vacuum vessel and acts as the blackbody radiator of outer space. Author

N64-31149 Virginia U., Charlottesville
[RESEARCH INVESTIGATION OF MAGNETIC AND ELECTRIC FORCES FOR ROTATING SHAFT SUSPENSION] Progress Letter for Jan. 1964
1 Feb. 1964 4 p
(Contract AF 33(657)-8352)
(EMI-3421-107-64U)

A design for new end magnets and a lightweight follower has been completed. The calculated tractive force of one of the proposed magnets is only 0.38 lb. A design has also been made for a precision radial displacement means with high restraining capability. A.W.

N64-31150 Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
ENGINEERING STUDY OF MULTIPURPOSE ENGINE AND FUEL SYSTEM FOR MANNED LUNAR BASES Monthly Report
K. Kasschau and C. E. Sinclair 31 Oct. 1963 305 p
(Contract DA-49-129-ENG-(NASA)-1)
(WANL-PR(S)002-B; AD-439835) OTS: $19.75

A state-of-the-art review is presented of the potential fuels and regeneration processes and of the current performance information on energy-conversion devices. Several systems were designed for the shelter power system as a means of establishing performance and system parameters that may be utilized in the future selection of a preferred concept. The total program schedule is outlined, and progress is described. D.E.W.

N64-31171 Research Management Associates, Inc., South Pasadena, Calif.
TEST SYSTEM ANALYSIS STUDY FOR PROPULSION RESEARCH ENVIRONMENTAL CHAMBER Technical Documentary Report, 20 May–12 Sep. 1963
M. R. Raleigh and R. Mickola Edwards AFB, Calif., AF Rocket Propulsion Lab., 23 Sep. 1963 331 p refs
(Contract AF 04(611)-9094)
(RTD-TDR-63-1083; RMA-63-123-100; AD-421020)

The feasibility of developing a facility for the testing of rocket propulsion systems employing high-energy, toxic, and hypergolic propellants under simulated space environmental conditions has been established through analytical studies. It is determined that two of the required modes of testing—propellant storage and main propulsion unit firing—can be achieved with a combination of a double-walled vacuum chamber and an exhauster system separated by an impermeable flexible metallic interface that allows full gimbaling of the rocket motor. The simulation of thermal flux to the test item due to solar and planetary radiations can be achieved through an array of incandescent lamps individually controlled by a computer-operated program. The testing of attitude-control rockets in the vacuum chamber (the third mode of testing) must be limited to very short durations to preserve vacuum integrity and assure rapid vacuum recovery, unless a special device, the molecular flow trap, is employed. Author

N64-31178 Boeing Co., Seattle, Wash.
LEADING EDGES DEVELOPMENT–DYNA SOAR, MODEL X-20 A
D. A. Bowers and Paul G. Esch [1963] 140 p
(Contract AF 33(657)-7132)
(D2-80085; AD-421746)

A series of five leading-edge concepts were subjected to three separate environment test programs. Each configuration was exposed to a sonic environment, a thermal gradient test, a second sonic exposure, and finally, a static load test. The purpose of these tests was to evaluate these five basic leading-edge concepts and their various design features to obtain information for a production configuration and to verify analytical procedures. Author

N64-31214* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
AN ADVANCED METHOD FOR AIRBORNE SIMULATION
Herman A. Rediess and Dwain A. Deets Repr. from J. Aircraft, v. 1, no. 4, Jul–Aug. 1964 p 185–190 refs Presented at the AIAA/AFFTC/NASA FRC Testing of Manned Flight Systems Conf., Edwards AFB, Calif., 4–6 Dec. 1963 Previously Announced: see N64-12880 04-10
(NASA-RP-337)

A model-controlled-system for airborne simulation that overcomes some disadvantages of present variable-stability airplanes has been studied analytically and proved feasible. This new approach has been a natural outgrowth of the development of model adaptive control systems and uses a similar model-following concept. Satisfactory matching of specific motion parameters can be obtained for model frequencies at least up to the natural frequency of the base airplane used for the airborne simulator. Time histories from analog studies of a simulator using a model-controlled system in a small subsonic jet transport and using a hypothetical supersonic transport as the model are presented as examples of the simulation performance expected. Author

N64-31257 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
MULTISYSTEM TEST EQUIPMENT Eighth Quarterly Technical Report, 1 Jan.–31 Mar. 1964
30 Apr. 1964 127 p
(Contract DA-36-034-AMC-0194Z)
(ATE-MTE-23; AD-440759)

Included are the following: descriptions of three test sets comprising the Land Combat Support Systems; reliability, maintainability, and value engineering analyses; test-set configurations; fabrication and performance testing of equipment; design and development of test support equipment; environmental testing of assemblies and a shelter; and activities of the Reliability Laboratory Test Program. Author

N64-31273 European Organization For Nuclear Research, Geneva (Switzerland) Accelerator Research Div.
A HIGH-PRECISION DEVICE FOR LENGTH MEASUREMENTS
J. Gervaise 24 Aug. 1964 38 p refs Transl. into ENGLISH of CERN-64-16
(CERN-64-39; CERN-64-16)

Length measurement in the field of large accelerator surveying is discussed, and a device developed for length measurement is described in particular. The principal components of the apparatus are these: invar wire, high-precision micrometer screw, steel-knife pivoting in a ball bearing, and a spirit level to guarantee the accurate reproducibility measurements. The device is very light, relatively easy to handle, and allows reproducibility with an accuracy of ±0.01 mm. Two types of measurements are discussed: (1) indoor measurements—positioning of magnets, focusing lenses, checking of small displacements of reference pillars, and gridding of experimental areas; and (2) outdoor measurements—trilateration for measuring ground stability and deformations in civil engineering work. P.V.E.

N64-31285 Boeing Co., Seattle, Wash.
LANDING IMPACT AND MANEUVER LOADS, EXHIBIT A Quarterly Progress Report No. 3, 1 Jan.–31 Mar. 1964
W. N. Mc Lean and G. R. Gannett 1 Apr. 1964 94 p refs Prepared Jointly with North American Aviation
(Contract AF 33(657)-11461)
(BNJV-A-Q3; AD-447076)

The status of the subject program to develop a simulation of two configurations of supersonic transports in the low-speed approach and landing maneuver is outlined. This includes a review of the program objectives, test program and procedures, and results of the first phase of the program, involving 720 landings. Since the quantity of analyzed data was so great, only the total composite results of all 720 landings, the composite results of each configuration, and the associated Cooper Ratings, statistical analysis, and dispersion plots for each setup are presented. Contained in the results is a statistical analysis of selected parameters at the middle marker, threshold, and at touchdown, Pearson Type III probability curves of applicable parameters at touchdown, and frequency histograms of airspeed and rate of descent at the middle marker and threshold. Author

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-30361 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
JOURNAL OF APPLIED MECHANICS AND TECHNICAL PHYSICS Selected Articles
17 Jun. 1964 24 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 4, 1963 p 68–73, 88–93 (FTD-MT-63-262; AD-602404) OTS: $1.00

CONTENTS:

1. THE COLLISION OF TWO PLATES WITH GREAT SPEED E. I. Andriankin p 1–10 refs (See N64-30362 22-11)

2. AN APPRAISAL OF THE ROLE OF RADIATION WHEN CALCULATING HEAT EXCHANGE IN A TURBULENT BOUNDARY LAYER S. S. Kutateladze, A. I. Leont'yev, and N. A. Rubtsov p 11–19 refs (See N64-30363 22-13)

N64-30362 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE COLLISION OF TWO PLATES WITH GREAT SPEED
E. I. Andriankin *In its* J. of Appl. Mech. and Tech. Phys., 17 Jun. 1964 10 p refs (See N64-30361 22-11) OTS: $1.00

Considered is the problem of collision of two plates with great speed, which results in the formation of impact gas, scattering into a vacuum. Almost all the energy of the gas is transmitted in the direction of the blow. A significant decrease in the flow of energy sets in only with an impact against a thick barrier. In the case of collision of plates with identical density and thickness such that the intensity of shock waves is constant, the problem is described as an accurate isentropic solution, correct for a number of discrete values of an adiabatic index. If the density of the striker is different from the density of the barrier, then accurate solution is found only for $\gamma = 3$. In the remaining cases, when the thicknesses of the striker and the barrier are arbitrary, a method of approximation is used, based on assignment of distribution of density in the form of a polynomial, whose coefficients are selected on the basis of the laws of conservation. Author

N64-30441 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
VISCOSITY OF MPD WORKING FLUIDS
I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res. Programme, Pt. 3: Theoret. [1964] 34 p refs (See N64-30440 22-24) OTS: $6.00

A theoretical evaluation of the viscosity of pure cesium and of the role of ionization under given temperature and pressure conditions is presented. These calculations are appropriate for a Rankine-cycle magnetoplasmadynamic generator using pure cesium as the working fluid. The viscosity of cesium–helium mixtures is also investigated, with particular attention given to the effects of the seeding fraction, because this combination is applicable to terrestrial base-load power generation. The general behavior of the viscosity of binary gas mixtures is examined. These calculations indicate that some gases exhibit a viscosity maximum that becomes more pronounced as temperature increases, which is contrary to the more usual cases where the maximum disappears. M.P.G.

N64-30469* Wisconsin U., Madison Theoretical Chemistry Inst.
ON THE DIFFERENTIAL EQUATIONS OF BRILLOUIN-WIGNER PERTURBATION THEORY
W. Byers Brown and William J. Meath Repr. from Proc. Natl. Acad. Sci., v. 52, no. 1, Jul. 1964 p 65–67
(Grant NsG-275-62(4180))

The Brillouin–Wigner perturbation theory was originally derived from the secular equations obtained from the spectral representation of the perturbed Schrödinger equation, in terms of the solutions of the unperturbed equation. The theory may also be derived directly from the Schrödinger equation in a very simple way, as is shown. Attention is focused on the differential equations themselves. R.L.K.

N64-30503* Lockheed-California Co., Burbank
[LAMINAR BOUNDARY LAYER AND CHARACTERISTIC SOLUTION FOR REAL GAS SHOCKWAVE INTERACTION WITH WEAK VORTEX SHEETS] Fifth Monthly Progress Report, Oct. 1–Oct. 31, 1963
[1963] 13 p refs
(Contract NAS2-1460)
(NASA-CR-56413) OTS: $1.00 fs; $0.50 mf

Discussed is work dealing with the following: (1) the treatment of the intersection of shock waves and shock waves with weak vortex sheets for real-gas effects; (2) the development of the laminar boundary-layer solution for real gas; and (3) the integrating of the laminar boundary-layer solution with the characteristic solution. P.V.E.

N64-30528 General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
A SOLUTION FOR THE INERTIAL ENERGY SPECTRUM OF ISOTROPIC TURBULENCE
Alan Q. Eschenroeder Aug. 1964 19 p refs
(Contract DA-04-495-ORD-3567(Z); ARPA Order 357-63)
(TR-64-02F; AD-446788)

A dynamic equation for quasi-stationary, inertially dominated, isotropic turbulence is formulated on the basis of a modified Obukhoff transfer term. By means of an elementary transformation, a self-similar solution for the energy spectrum is obtained. The closed-form expression for an inertial range in the quasi-equilibrium regime obeys previously derived functional laws for large and small wave numbers. Matching the analytical result with an experimentally determined coefficient in the large-wave-number limit gives consistent scaling of terms over the energy-containing eddy range of the spectrum. Author

N64-30561 Polytechnic Inst. of Brooklyn, N.Y.
A STUDY OF THE IMPULSIVE MOTION OF A SEMI-INFINITE FLAT PLATE USING A LINEAR MODEL OF THE UNSTEADY BOUNDARY LAYER EQUATIONS
Robert C. Ackerberg Dec. 1963 21 p refs
(Grant AF-AFOSR-1-63)
(PIBAL-821; AD-602867)

The impulsive motion of a semi-infinite flat plate in a fluid initially at rest is studied using a linear model of the unsteady boundary layer equations and conventional Fourier and Laplace transform techniques. By imposing the physical condition that the skin friction be integrable at the leading edge, a unique solution is found. All transforms are inverted in a formal way using a theorem on Laplace transforms due to Van der Pol, and the non-unique solutions are discussed. Author

N64-30593 Aerojet-General Corp., Azusa, Calif. Von Karman Center
HYDRODYNAMIC CHARACTERISTICS OF BASE-VENTED AND SUPERCAVITATING STRUTS FOR HYDROFOIL SHIPS. ILLUSTRATIONS
E. R. Bate et al Aug. 1964 367 p For Abstract See N64-30597 22-11
(Contract NObs-84664)
(Rept.-2796, Vol. II; AD-605178)

N64-30597 Aerojet-General Corp., Azusa, Calif. Von Karman Center
HYDRODYNAMIC CHARACTERISTICS OF BASE-VENTED AND SUPERCAVITATING STRUTS FOR HYDROFOIL SHIPS VOLUME I: TEXT AND APPENDIXES
E. R. Bate Aug. 1964 204 p refs
(Contract NObs-84664)
(Rept.-2796, Vol. I; AD-605177)

The experimental program consisted of two phases, a basic strut investigation and a study of the effect of rudders on a selected strut. The basic strut investigation consisted of

the following: (1) exploratory tests in which the experimental techniques and equipment were checked out, and a comparison of results obtained with a straight model and with a model curved to the towing radius; (2) a study of drag optimization of basic sections; (3) cross force and yaw moment studies; (4) an evaluation of the effect of strut geometry (thickness ratio and rake); and (5) a study of the effect of scale (size and speed) as represented by Froude number. The rudder study was concerned with the effect of rudder geometry (i.e., chord ratio, span ratio, and spanwise location of the rudder) on a selected strut section. This volume contains a presentation and analysis of results of the experimental program.
Author

N64-30614 Johns Hopkins U., Baltimore, Md.
A THEORY OF SMALL-AMPLITUDE LONG WAVES
Robert R. Long Jun. 1964 23 p refs
(Contract Nonr-4010(01); Grant WBG-21)
(ONR-TR-16; WBG-TR-19; AD-602824) OTS: $1.00

A theory of small-amplitude, long water waves is developed by expansion in terms of the two small parameters involved. The first approximation is required to be the familiar equations of infinitesimal, long waves. An investigation is made of the accuracy of the classical equations of finite-amplitude, hydrostatic disturbances. It appears that the simple hydrostatic approximation neglects terms that are just as important as those retained, although in certain cases the equations of hydrostatic disturbances may be useful to predict developments for limited periods of time. The first few sets of differential equations are integrated in a special case. The study leads to the derivation of the properties of a new kind of finite-amplitude long wave.
Author

N64-30616 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany) Inst. für Theoretische Gasdynamik
THE UNSTEADY FLOW PROCESS SUBSEQUENT TO THERMAL CHOKING [INSTATIONARE STROMUNGSVORGANGE BEI UBERSCHREITEN DER KRITISCHEN WARMEZUFUR]
Fritz Bartlma Repr. from Z. Flugwiss. (Brunswick, W. Ger.), v. 11, no. 4, 1963 p 160–168 In GERMAN
(DVL-285)

Heat is presumed to be supplied uniformly to a steady channel flow with constant cross section until thermal choking is reached. The unsteady flow process that occurs when heat supply is further increased is calculated, assuming that the additional heat supply is small compared to the enthalpy of gas. The restrictive assumption of a stationary heat level of a preceding paper has been abandoned here. Analytical solutions for the subsonic and supersonic region as well as for the transonic region can be obtained when a suitable linearization is used. Comparison of these results with exact calculations shows good agreement.
Author

N64-30644 Space Technology Labs., Inc., Redondo Beach, Calif.
HYPERSONIC WAKE PROJECT Annual Report, Jul. 1, 1963–Jun. 30, 1964
Leslie A. Hromas Jul. 1964 24 p refs
(Contract AF 04(694)-440)
(STL-6433-6007-SU-000; BSD-TDR-64-113; AD-443815)

The current work includes analyses of reentry vehicle properties in the areas of nonequilibrium turbulent wake flows, the laminar base region, injection and ablation properties, and inviscid nonequilibrium flow. In addition, the report gives the project background, history, and relation to other current projects.
Author

N64-30647 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METHOD OF CALCULATION OF FLOW OF RAREFIED GAS
B. V. Kuksenko 3 Jun. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 5, 1963 p 1042–1045
(FTD-MT-64-114; AD-602308)

The main difficulty in calculating the aerodynamics of rarefied gases is in finding solutions to the functions of many variables (4 or more) that result. A method is presented, proceeding from the integral equation f = V(f), of constructing a system of equations (each involving a small number of independent variables) that, when solved, will provide approximate solutions to problems involving the aerodynamics of rarefied gases.
P.V.E.

N64-30658 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
IONIZATION OF CESIUM AND SODIUM CONTAMINATED AIR IN THE HYPERSONIC SLENDER BODY BOUNDARY LAYER
M. Lenard Aug. 1964 32 p refs
(R64SD22)

An approximate procedure is used to predict the effect on air ionization of small amounts of cesium and sodium in the ablating surface material of pointed cones. Ionization is assumed to occur due to finite rate gas phase chemical reactions in the laminar boundary layer. An 11-species (N_2, O_2, N, O, NO, Cs or Na, NO^+, Cs^+ or Na^+, O_2^-, O^-, e^-), 16-reaction chemical system is assumed.
Author

N64-30661 RAND Corp., Santa Monica, Calif.
INVESTIGATION OF THE FLOW AND DRAG DUE TO SUPERSONIC JETS DISCHARGING UPSTREAM INTO A SUPERSONIC FLOW
Andrew F. Charwat Jul. 1964 40 p refs
(AD-603354)

The flow generated by a supersonic jet issuing from the nose of a blunt body upstream in a supersonic flow can fall into two typical classes: (1) a steady flow characterized by a shock layer between two strong shocks; and (2) an unsteady flow resembling a jet spike. The dominant condition that couples these flows can be isolated by inspection; on the axis of symmetry, both streams must come to rest, and, therefore, their impact pressures at that point must be equal. This report explores, in addition to some details of the blunt-body structure of the interactions, a conceptual model of the interaction that provides a second condition of compatibility between the jet and the outside flow. The proposed model, which uses retrojets, focuses attention on the dead-air region adjacent to the base ring between the jet and the outside diameter of the body. The flow around isobaric boundaries of this region must be able to close by turning through a series of shocks and expansions, which is not generally possible for an arbitrary geometry of the boundary. Instability and transition to a spike-type flow follows when the required conditions for closure are not met.
I.v.L.

N64-30671 Aix-Marseille U. (France) Inst. of Fluid Mechanics
INFLUENCE OF THE CAMBER ANGLE ON THE DISTRIBUTION OF THE FLUX DENSITY OF CONVECTED HEAT ON THE SURFACE OF A DELTA WING WITH ZERO INCIDENCE [INFLUENCE DE L'ANGLE DE FLECHE SUR LA REPARTITION DE LA DENSITE DE FLUX DE CHALEUR CONVECTEE A LA SURFACE D'UNE AILE EN DELTA A L'INCIDENCE ZERO]

R. Marmey, J. P. Guibergia, B. Tocquet, and J. Valensi [1963] 42 p refs In FRENCH
(Contract DRME-63-34042-01-480-75-01)

Tests conducted in a shock-type wind tunnel led to the determination of the flow of convected heat on delta wings with large camber angles ($\lambda = 80°$ and $\lambda = 70°$), the results of which are presented in graphic form. A thermometric method utilizing thin platinum films was responsible for the satisfactory results obtained. The values of the coefficient of heat convection obtained on the mockup of a delta wing, with a camber angle of $\lambda = 80°$ and $\lambda = 70°$, in the hypersonic wind tunnel at Mach 7 and the values obtained in the shock tunnel at Mach 9 were in good agreement. Local effects that are due to the separation of the boundary layer along the stagnation line and around the point of discontinuity of the camber give rise to more pronounced effects at Mach 9 than at Mach 7. Appendixes pertaining to the following are presented: (1) calculation of the flow Mach number in the nozzle; (2) interface adaptation conditions; (3) measurement of the time of the theoretical gust; and (4) the flow of convected heat at the stagnation point. I.v.L.

N64-30672 Aix-Marseille U. (France) Inst. of Fluid Mechanics
IDENTIFICATION AND FORECAST OF THE STATE OF A GAS BEFORE AND AFTER EXPANSION IN A WIND TUNNEL FOR REFLECTED SHOCKS [IDENTIFICATION ET PREVISION DE L'ETAT DES GAZ AVANT ET APRESDETENTE DANS UNE SOUFFLERIE A CHOC REFLECHI]
J. Gard, R. Chareyre, and H. Guenoche [1963] 53 p refs In FRENCH
(Contract DRME-63-34042-01-480-75-01)

A study of the state of the gas behind a reflected shock in the area around the end of a shock tube is discussed in the light of contributing to the study of flow in a shock-type wind tunnel. The volumetric mass of the gas and its evolution were determined by interferometry for shock waves in the Mach range of 5, 3, and 8, within the general framework of a shock for which the conditions of interface adaptation—nitrogen and oxygen—are effected. In addition, observations were made of the flow in the test section of a shock-type wind tunnel for the purpose of showing the perturbations that propagate in the flow and of attempting to connect these perturbations with those that exist in the gas tank. Trans. by I.v.L.

N64-30835* Consultants and Designers, Inc., Arlington, Va.
ENERGY LOSSES UNDERGONE BY RARE GASES' FAST IONS (80 keV) AFTER COLLISION WITH HELIUM AND NEON ATOMS [PERTES D'ENERGIE SUBIES PAR DES IONS RAPIDES (80 keV) DE GAZ RARES APRES COLLISION AVEC DES ATOMES DE GAZ RARES (HELIUM, NEON)]
Michel Barat, Jacques Baudon, and Albert Septier 5 Aug. 1964 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 258, no. 22, Jun. 1964 p 5379–82
(Contract NAS5-3760)
(NASA-TT-F-8941; ST-AP-10187) OTS: $1.00 fs; $0.50 mf

Ion collisions with atoms of rare gases were studied using a high-resolution speed analyzer. The following cases were considered: He^+ with He, Ne^+ with He, A^+ with He, He^+ with Ne, Ne^+ with Ne, and A^+ with Ne. The observed energy losses are due to elastic and inelastic collisions. The collisions correspond to excitations or ionizations; the charge-exchange phenomena do not interfere in this operational mode. The interval between two successive levels is generally less than 2 eV; only those excitation levels extending to the first ionization level are observed. I.v.L.

N64-30881 Harvard U., Cambridge, Mass. Engineering and Applied Physics Div.
TRANSITION IN CIRCULAR COUETTE FLOW
Donald Coles Apr. 194 79 p refs
(Contract Nonr-1866(20))
(AD-603095)

Two distinct kinds of transition found in the Couette flow between concentric rotating cylinders are discussed. The first kind—transition by spectral evolution—is characteristic of the motion when the inner cylinder has a larger angular velocity than the outer one. As the speed increases, a succession of secondary modes is excited; the first is the Taylor motion (periodic in the axial direction); and the second is a pattern of traveling waves (periodic in the circumferential direction). This kind of transition may be viewed as a cascade process in which energy is transferred by nonlinear interactions through a discrete spectrum to progressively higher frequencies in two-dimensional wave numbers. The second kind of transition—catastrophic transition—is characteristic of the motion when the outer cylinder has a larger angular velocity than the inner one. At a fixed Reynolds number, the fluid is divided into distinct regions of laminar and turbulent flow, and these regions are separated by interfacial surfaces that may be propagating in either direction. I.v.L.

N64-30918 David Taylor Model Basin, Washington, D.C. Hydromechanics Lab.
EXPERIMENTAL INVESTIGATION OF NEAR-SURFACE HYDRODYNAMIC FORCE COEFFICIENTS FOR A SYSTEMATIC SERIES OF TEE HYDROFOILS, DTMB SERIES HF-1
Jerome Feldman Dec. 1963 101 p refs
(DTMB-1801; AD-432263)

Experiments were conducted with the Planar-Motion-Mechanism System to determine the normal and longitudinal components of force for DTMB Series HF-1, a systematic series of Tee foils designed to operate in the subcavitating regime. The resulting data are presented in a form applicable to the hydrodynamic design of high-speed hydrofoil craft from the standpoint of stability and control. The data are further analyzed to establish the effects of parameters such as Froude Number, depth of submergence, and aspect ratio. Comparisons are made to determine the extent to which existing theories produce agreement with the experimental data. Author

N64-30956 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
A DISCRETE ORDINATE TECHNIQUE FOR THE LINEARIZED BOLTZMANN EQUATION WITH APPLICATION TO COUETTE FLOW
B. B. Hamel and M. Wachman Aug. 1964 51 p refs
(Contract AF 49(638)-1283)
(R64SD53; AD-604749)

A numerical method for the solution of the linearized Boltzmann equation of hard sphere molecules is developed here, in which approximations are made only in the sense of numerical truncations. The distribution function is considered at n discrete points in velocity space, and a closed symmetric set of differential equations is developed that describes the evolution of the distribution function at each of these discrete points. The key point of the method is the approximation, by a finite sum, of the collision integral, utilizing Gauss quadrature (integration) formulas. The method is applied to the problem of linearized Couette flow of hard sphere molecules. Numerical results are obtained for the moments and for the perturbation distribution function at the discrete points. Author

N64-30996* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FLUX PATTERNS RESULTING FROM FREE-MOLECULE FLOW THROUGH CONVERTING AND DIVERGING SLOTS
Thaine W. Reynolds and Edward A. Richley Washington, NASA, Oct. 1964 71 p refs
(NASA-TN-D-1864) OTS: $1.75

Equations for the determination of particle flux at a location downstream of the exit of convergent and divergent two-dimensional slots for gas flow through the slot under free-molecule conditions have been derived and solved numerically. Slot configurations range from length to inlet width ratios of 0.25 to 8 and wall half-angles from 75° divergent to 60° convergent. Flux distribution patterns along surfaces of constant radius from the slot exit centerplane and in planes normal to the slot centerplane are presented for varying distances from the slot exit. Flux along the centerplane close to the slot exit is higher for the smaller length-to-width-ratio slots and becomes less a function of the length-to-inlet-width ratio of the slot increases, the angle giving maximum flux along the centerplane approaches zero (i.e., a parallel-walled slot). A maximum value of flux along the centerplane is obtained in the far field with divergent slots. Author

N64-30999* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE EQUILIBRIUM FREE SURFACE OF A CONTAINED LIQUID UNDER LOW GRAVITY AND CENTRIFUGAL FORCES
W. Thomas Blackshear and Donald G. Eide Washington, NASA, Oct. 1964 23 p refs
(NASA-TN-D-2471) OTS: $0.75

A general differential equation has been derived that governs the three-dimensional equilibrium free surface as a function of an inertial field due to translational acceleration, angular velocity, and surface tension. Because of the nonlinear character of this equation, a complete closed form solution is not presently possible. However, a closed form solution is presented that is valid when the capillary forces acting on the liquid may be neglected. When the capillary forces are of the same order of magnitude as the inertial forces acting on the liquid, attention is restricted to two dimensions, and solutions are obtained by numerical integration in an effort to display the effects of various parameters on the free surface shape. Representative two-dimensional solution curves are presented and discussed for various magnitudes of translational acceleration, rotational rate, liquid-to-solid contact angle, and vapor volume. Author

N64-31028 Hydronautics, Inc., Laurel, Md.
FULLY CAVITATING HYDROFOILS IN NON-STEADY MOTION UNDER A FREE SURFACE
C. C. Hsu Aug. 1963 39 p refs
(Contract NObs-84296)
(TR-119-5; AD-601100) OTS: $2.00

A linearized theory is developed for unsteady two-dimensional cavity flow about thin hydrofoils at zero cavitation number. Expressions are presented for the lift and moment coefficients of a thin supercavitating foil performing arbitrary oscillations, in terms of the coefficient of a power series describing the chordwise amplitude distribution. They are applied to the case of a rigid foil performing heaving and pitching oscillations and to that of oscillating flaps. For very large depth–chord ratios, the lift and moment coefficients for pure heaving and pitching oscillations are identical to those obtained by other workers. Author

N64-31063 Naples U. (Italy) Inst. of Aeronautics
GENERALIZED VELOCITY POTENTIAL EQUATION FOR PLURI-REACTING MIXTURES Technical Note No. 5
L. G. Napolitano Aug. 1963 48 p refs
(Contract AF 61(052)-327)
(IA-103; AD-600098) OTS: $2.00

The velocity potential equations for linearized steady motions of gas mixtures in which either a single reaction or two independent reactions take place have been derived previously. The purpose of the present paper is to derive and discuss the potential equation for the general case in which any number of independent reactions take place. The derivation of the generalized potential equation and the analysis of its essential features are presented. The limiting forms assumed by the potential equation when a number of reactions can be considered either frozen or in equilibrium are derived and discussed. Explicit expressions for indicative cases of plane motions are listed. Author

N64-31066 ARO, Inc., Arnold Air Force Station, Tenn.
AN INFLUENCE OF THE ORIFICE ON MEASURED PRESSURES IN RAREFIED FLOW
J. Leith Potter, Max Kinslow, and David E. Boylan Arnold Eng. Develop. Center, Sep. 1964 36 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-175; AD-447734)

The relation between pressure in an orifice cavity and the true pressure on the surface of a cooled or heated body in rarefied but not necessarily free molecular flow is discussed. First, the existence of an "orifice effect" is demonstrated by making use of data from impact-pressure probes in low-density hypersonic flows. Then, an analysis is presented that leads to a prediction of the influence of heat transfer on the pressure inside an orifice cavity when the orifice diameter is much less than the mean free path at the orifice entrance. Results of the analysis are supported and extended to lower Kundsen numbers by an experiment using argon and nitrogen gases. Author

N64-31067 ARO, Inc., Arnold Air Force Station, Tenn.
INJECTION OF PARTICLES THROUGH A JET NOZZLE LATERALLY INTO A SUPERSONIC AIRSTREAM
E. E. Hilliard Arnold Eng. Develop. Center, Sep. 1964 17 p ref
(Contract AF 40(600)-1000)
(AEDC-TDR-64-181; AD-447862)

Tests were conducted in a 12-in. supersonic tunnel to determine the particle distributions downstream of a nozzle exhausting particle-laden flow laterally into the airstream from the tunnel floor. Data were obtained at Mach 3 for a range of jet pressure ratios and nozzle sizes with the nozzles located at several positions upstream of the sampling rake. Reynolds number ranged from 0.15 to 0.62 × 10^6 per inch. Selected results are presented. Author

N64-31070 Catholic U. of America, Washington, D.C.
VIBRATIONAL RELAXATION IN HYDROGEN CHLORIDE Final Report
Jarus W. Quinn 1 Jun. 1964 50 p refs
(Contract AF 19(604)-5558)
(AFCRL-64-559; AD-447205)

The equilibration of the vibrational degree of freedom of hydrogen chloride was studied at pressures below 3 cm of mercury. The gas was excited to emission in a pulsed, microwave discharge. The light was dispersed by a monochromator and its intensity measured as a function of time for all resolved vibration-rotation lines in the region of the HCl fundamental. All transitions gave rise to an exponential light decay with no

dependence on the rotational quantum number, vibrational quantum number, or branch of the band. The lifetime increases linearly with pressure in the region above 0.5 cm of mercury. Below this pressure the lifetime was essentially constant. In view of the fact that the intensity of the light emission is proportional to the number of molecules in a particular excited state, these measurements give a direct measure of the population density of the excited gas. Author

N64-31115 General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
NONEQUILIBRIUM RADIATION FROM THE STAGNATION REGION OF HIGH-VELOCITY BODIES
C. Frederick Hansen and Claire E. Chapin Aug. 1964 44 p refs (Contract DA-04-495-ORD-3567(Z); ARPA Order 357-63; Proj. Defender)
(TR64-02G; AD-447570)

Calculations of the radiation produced in the gas cap of spheres traveling through air at velocities from 14,000 to 22,000 fps are described. Results are compared with experimental data. At these velocities the flow and the radiation are uncoupled, and the solution proceeds in two steps: (1) The thermodynamic state of the gas is found at each point in the flow, accounting for nonequilibrium states of species concentration and vibrational excitation. (2) This nonequilibrium-flow solution is used as input for calculating the radiative flux emerging from the gas cap. Author

N64-31225* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF COMPRESSIBILITY AND HEAT TRANSFER ON THE LAMINAR SUBLAYER OF THE TURBULENT BOUNDARY LAYER
K. R. Czarnecki and William J. Monta Washington, NASA, Oct. 1964 46 p refs
(NASA-TN-D-1998) OTS: $1.25

An analytical investigation has been made of the effects of compressibility and heat transfer on the characteristics of the laminar sublayer. The theoretical model consisted of a turbulent boundary layer with a logarithmic nondimensional outer velocity distribution that was not affected by compressibility or heat-transfer effects, and a laminar sublayer that was influenced by these parameters. The analysis indicates that at zero heat transfer an increase in Mach number at constant free-stream Reynolds number per foot causes an increase in the nondimensional velocities of the sublayer and a rapid increase in the sublayer thickness. This effect is largest where the local skin-friction coefficient is highest. Boundary-layer cooling has a strong effect opposite to that of increasing Mach number. Author

N64-31263 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
ON THE RELAXATION OF A LIGHTHILL-FREEMAN GAS
Reuben R. Chow Oct. 1963 21 p refs
(RE-167; AD-421539)

A perturbation scheme based on Freeman's nonequilibrium dissociation–recombination gas model has been introduced in the investigation of the stability of a flow system about the equilibrium point. The analysis shows that the stability criteria can be obtained without knowledge of the actual relaxation time of the nonequilibrium gas. The lines of neutral stability have been obtained as functions of the equilibrium temperature, the equilibrium density, and the equilibrium dissociation fraction of the single component diatomic gas. Two special cases of particular significance have been examined. For a very slowly moving gas, the speed ratio does not affect the stability criteria, and the adiabatic system is always stable under small disturbance. For a gas either slightly or almost fully dissociated, the sonic point in the moving gas is a critical one. In this latter case, the disturbance tends to decay in the subsonic region and magnify in the supersonic region. Author

N64-31296 Advisory Group for Aeronautical Research and Development, Paris (France)
WALL-PRESSURE FLUCTUATIONS AND PRESSURE-VELOCITY CORRELATIONS IN TURBULENT BOUNDARY LAYERS
John S. Serafini Apr. 1963 73 p refs
(AGARD-453)

Pressure fluctuations of a turbulent layer along a plane boundary have been investigated experimentally. All measurements were made at a nominal free-stream Mach number of 0.6 and an average Reynolds number per foot of 3.45×10^6 in a wind-tunnel facility specially designed for the purpose. The pressure fluctuations were measured with miniature pressure transducers and the velocity fluctuations with hot-wire anemometers. The root-mean-square magnitudes of the wall-pressure fluctuations agree with the Lilley–Hodgson theoretical results, whereas the mean-square spectra do not agree, except over a small range of frequencies. Space–time correlations of the wall-pressure fluctuations generally agree with Willmarth's experimental results for longitudinal separation distances. Measurements of lateral space–time correlations indicated that the ratio of the longitudinal to lateral length-scale is approximately 7.4. The convection velocity of the fluctuations is found to increase with increasing separation distances, and its significance is explained. Author

N64-31304 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
EXPERIMENTAL STUDY OF HIGH SPEED HYDROFOILS, VOLUME I. PARTS I–III WITH APPENDICES
H. R. Wright, Jr. 26 Aug. 1963 253 p
(Contract NObs-84454)
(XAR-A-45; AD-447963)

Twenty hydrofoil models were tested in a whirling tank at three depths and at a sufficient number of speeds and angles-of-attack to fully define their hydrodynamic characteristics. Lift, drag, pitching moment, and strut base pressure were measured for all models, and cavity pressure and foil base pressure were measured for the supercavitating models. Classic supercavitating hydrofoil theory is shown to predict test results with an accuracy adequate for design if a modified value for the cross-flow lift coefficient is accepted. Author

N64-31318 United Aircraft Corp., East Hartford, Conn. Research Labs.
LAMINARIZATION OF NOZZLE WALL BOUNDARY LAYERS AS A MEANS OF REDUCING HEAT FLUX Quarterly Progress Report No. 2, 1 Apr.–30 Jun. 1964
R. L. O'Brien and P. E. Demarest Jul. 1964 33 p refs
(Contract AF 04(611)-9576)
(C-910100-11; AD-443619)

Detail calculations of the heat-transfer rates on the test models have been performed for both laminar and turbulent boundary layers at the throat of the nozzles for a range of Reynolds numbers and wall temperatures. Several methods of calculating the heat flux were compared. Fabrication of the test facility was continued. The test rig is currently 90% complete. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-30378 Michigan U., Ann Arbor Acoustics and Seismics Lab.
PROCEEDINGS OF THE VESIAC CONFERENCE ON SEISMIC EVENT MAGNITUDE DETERMINATION
May 1964 135 p refs Conf. held at Calif. U., 11–12 Apr. 1963
(Contract ARPA-SD-78)
(Rept.-4410-71-X; AD-441592)

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8. AN INVESTIGATION OF THE RELATIONSHIP BETWEEN MAGNITUDE SCALES FOR SMALL SHOCKS C. F. Romney (AF Tech. Appl. Center) p 83–92 refs (See N64-30386 22-12)
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11. SYSTEMATIC DEVIATIONS OF MAGNITUDE FROM BODY WAVES AT SEISMOGRAPH STATIONS IN THE UNITED STATES J. W. Guyton (Geo. Tech. Corp.) p 111–126 refs (See N64-30389 22-12)
12. ASPECTS OF MAGNITUDE DETERMINATIONS IN THE UNITED STATES COAST AND GEODETIC SURVEY L. M. Murphy and J. N. Jordan (Coast and Geodetic Surv.) p 127–135 refs (See N64-30390 22-12)

N64-30379 California Inst. of Tech., Pasadena
HISTORICAL BACKGROUND OF THE MAGNITUDE SCALE
C. F. Richter *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 1–12 *Its* Contrib. No. 1247 (See N64-30378 22-12)

Included in the discussion of the historical background of the magnitude scale are the following subjects: earthquake intensity and maximum accelerations of the ground surface; seismicity—relative level of earthquake activity in different areas; distortion of statistics based on uncritical use of earthquake information; unpublicized major earthquakes; relationship between magnitude and energy; and divergence between body-wave and surface-wave scales. P.V.E.

N64-30380 St. Louis U., Mo.
A REVIEW OF RUSSIAN WORK IN MAGNITUDE DETERMINATION
William Stauder *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 13–40 refs (See N64-30378 22-12)

The evolution of the magnitude scale in the U.S.S.R. is described, and areas of its application are indicated. The development of an energy scale, which is an outgrowth of the magnitude scale in the U.S.S.R., is outlined. In conclusion, it is indicated that Russian development of the magnitude scale has been quite similar to the development in other countries. Soviet seismologists, however, have used to a greater extent formulas for surface waves of the form $M = \log A/T - \log (A/T)^*$ rather than $M = \log A - \log A^*$, where A is maximum (total) surface-wave ground displacement in microns, T is the period of the maximum, and $\log (A/T)^*$ is the quantity corresponding to the standard shock. In devising an energy scale, a practical method has been worked out for the equicentral range $0 < \Delta < 700$ km, whereby an energy class, K, is determined for any given earthquake. The K number is related to energy by $K = \log E$ (joules). P.V.E.

N64-30381 Institute for Defense Analyses, Washington, D.C.
THE DETERMINATION OF ENERGY IN SEISMIC WAVES
John De Noyer *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 41–49 refs (See N64-30378 22-12)

The use of body waves and surface waves to determine the energy in seismic waves is discussed. Also discussed is the processing of raw data and the determination of energy in various seismic phases. It is concluded that the degree to which observational seismology, theoretical seismology, and computer technology have developed during the past few years, makes it possible to greatly improve estimates of the energy in seismic waves, and that it is desirable as a method of investigating earthquake-source mechanisms and properties of propagation paths, as well as of finding better magnitude–energy relationships. P.V.E.

N64-30382 Texas Instruments, Inc., Dallas
MAGNITUDE DETERMINATION PROBLEMS FOR THE WORLDWIDE COLLECTION AND ANALYSIS PROGRAM
Renner B. Hofmann *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 51–57 refs (See N64-30378 22-12)

Determination of earthquake magnitudes at short distances is discussed. These are the conclusions reached: (1) very high, positive station magnitude (M_{PZ}) corrections for short-period seismograph systems are obtained by comparing published magnitudes with calculated magnitudes; (2) this correction does not apply at less than shadow-zone distances; (3) the average M_{PZ} station correction for six of eight specific instrument types, distributed worldwide, shows increasing positive values with decreasing average bandpass period and bandpass width; and (4) possible explanations for these phenomena are

the higher-than-normal attenuation of the short-period components of P waves by the shadow-zone mechanism, and variation in the position of the available broad P-energy spectrum passed by any specific instrument. P.V.E.

N64-30383 Texas Instruments, Inc., Dallas
LIMITATION OF CORRECTION FACTOR APPLICATION TO MAGNITUDE FORMULAS
Renner B. Hofmann *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 59–61 refs (See N64-30378 22-12)

Within the normal errors inherent in a single magnitude determination at conventional observatories, a station magnitude correction is shown to provide reasonable magnitudes for teleseisms, regardless of the cause of anomaly. If, from a different point of view, the relationship between unified magnitudes, m, and the Richter magnitude M is desired, then M determined by established stations can be plotted against m determined by the station to be calibrated. The best line through the points will then establish the conversion formula. However, this slope constant is generally difficult to determine from plots of m determined at a single station against $M_{published}$ for a few months of time, because both have an accuracy limitation of about ± 0.5 M units, and most well-recorded shocks for which a magnitude has been published are between $M = 5.5$ and $M = 6.5$. P.V.E.

N64-30384 Texas Instruments, Inc., Dallas
A STUDY OF MAGNITUDE DETERMINATIONS FROM WORLDWIDE DATA
Ray L. Fisher *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 63–73 (See N64-30378 22-12)

Seismic data from six seismic stations are discussed—Resolute Bay, Canada; Brisbane, Australia; Rome; Baguio, Philippine Islands; Hong Kong; and Lwiro, Congo. Graphs showing the following are presented and discussed: (1) the value of the body-wave magnitude, m, calculated from the maximum amplitude (peak-to-peak/2) of the P phase as recorded on the vertical component, against the average of all reported magnitudes; (2) the body-wave magnitude calculated from the maximum amplitude of the S phase (m_s recorded on the horizontal components) plotted against the published magnitudes of the same data; (3) the m_b vs the published magnitudes (the value of m_b is determined by first finding the average value of m_p by using long-period and short-period vertical and horizontal components, then averaging this with m_s); and (4) the relation between m_p and M_R, which is the magnitude calculated from the vertical component of 20-sec. surface waves. P.V.E.

N64-30385 Texas Instruments, Inc., Dallas
MAGNITUDE CALCULATION FOR THE WORLDWIDE COLLECTION AND ANALYSIS PROGRAM
Renner B. Hofmann and Robert W. Wylie *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 75–81 refs (See N64-30378 22-12)

Several methods of magnitude determination that are in common use are outlined, and the advantages and limitations of each are pointed out. Also the methods and conditions under which each may be used are presented. The methods outlined are these: (1) body-wave (P) method; (2) the 20-sec. surface-wave (H-components) method for teleseisms; (3) the 20-sec. surface-wave (V component) method for teleseisms; (4) body-wave (S) method for teleseisms; (5) body-wave (PP) method for teleseisms; and (6) body-wave unified magnitude (m) method. P.V.E.

N64-30386 Air Force Technical Applications Center, Washington, D.C.
AN INVESTIGATION OF THE RELATIONSHIP BETWEEN MAGNITUDE SCALES FOR SMALL SHOCKS
Carl F. Romney *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 83–92 refs (See N64-30378 22-12)
(AFTAC-TR-VU-63-4)

Preliminary results of an investigation of the relationship between m_b and M_s for earthquakes as small as magnitude 4 are discussed. It is concluded that while the data are insufficient, as yet, to provide an accurate relationship between m_b and M_s, it is clear that the Gutenberg–Richter formula requires revision when m_b is determined from short-period recordings. From the data presented and with the assumption that the m_b and M_s scales coincide at magnitude 7, it is indicated that M_s equals m_b (approximately) between magnitude 4 and magnitude 7. An implication of the study is that earthquakes in the magnitude 4 to 6 range seem to be approximately point impulsive sources. This is inferred from the fact that the spectrum does not change appreciably over this range. This would be expected if the time of faulting is short compared to one wavelength of P. The data appear to be consistent with a formula given by Tocher who found that the length of faulting, as judged from surface breaks, is 1 km for a magnitude 5.6 earthquake, and increases exponentially with magnitude. P.V.E.

N64-30387 California U., Berkeley
SOME FACTORS AFFECTING THE LOCAL EARTHQUAKE MAGNITUDE SCALE
Don Tocher *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 93–97 (See N64-30378 22-12)

Factors (including source strength, distance, and station corrections) that affect the recorded amplitudes of seismic waves at a particular station are discussed. An attempt to test the assumption that the Richter published tables of log A_0 vs epicentral distance applies to central California as well as southern California is also discussed. It was found that even between two areas as near as southern and central California, a detectable difference appears, even when using the same group of earthquakes. P.V.E.

N64-30388 Atomic Weapons Research Establishment, Aldermaston (Gt. Brit.)
SOME OBSERVATIONS FROM LARGE ARRAYS
H. I. S. Thirlaway *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 99–110 (See N64-30378 22-12)

In amplitude studies of array teleseismic recordings, relative coupling factors of two or three are observed within areas of about 100 km^2 that include the same rock type and regional structure. Part of this is evidently due to variation in the geophone plant. Another contribution to amplitude variations is interference by spurious signals. Signals with low S/N must contain significant components from noise of similar frequency, whereas all signals can contain components from noise generated by the P signal itself. Noise of this type can be cleared up by the insertion of appropriate delays and cross-correlation processes if the linear dimensions of the array are equivalent to the P signal's wavelength. The contribution to coupling factors by the seismometer plant would be expected to be constant, and the interference contribution would be random; consequently, magnitude observations at a given seismometer of events from the same location could be expected to be consistent within one-half order of magnitude; this has been confirmed by observation. P.V.E.

N64-30389 Geotechnical Corp., Garland, Tex.
SYSTEMATIC DEVIATIONS OF MAGNITUDE FROM BODY WAVES AT SEISMOGRAPH STATIONS IN THE UNITED STATES
J. W. Guyton *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 111–126 refs (See N64-30378 22-12)
(Contract AF 49(638)-1150)
(TR-64-1, Pt. 1)

An investigation of systematic deviation in the determinations of m_b for each of 27 seismograph stations with standardized instrumentation is discussed. The results of the investigation indicate that the local geologic setting of the station sites influences signal level, and that, in general, stations above thick sequences of low-density sedimetary rock record higher amplitudes than stations located on granitic basement. There is also an apparent regional effect in that stations located on granitic basement in the Eastern United States tend to record higher amplitudes than stations located on granitic basement in the Western United States. it is tentatively suggested that this apparent regional difference is related to large-scale differences in the crust and upper mantle in the Eastern and in the Western United States. P.V.E.

N64-30390 Coast and Geodetic Survey, Washington, D.C.
ASPECTS OF MAGNITUDE DETERMINATIONS IN THE UNITED STATES COAST AND GEODETIC SURVEY
L. M. Murphy and J. N. Jordan *In* Mich. U. Proc. of the VESIAC Conf. on Seismic Event Magnitude Determination May 1964 p 127–135 refs (See N64-30378 22-12)

A computer program for determining magnitudes of seismic events is discussed, and a program instituted to study body-wave magnitudes is outlined. The principal considerations of the programs are these: (1) the nature of the propagation path; (2) the nature and mechanism of forces at the focus; (3) the depth of focus; (4) energy range at the focus; and (5) the response characteristics of the detectors. P.V.E.

N64-30452 Academy of Sciences (USSR), Moscow
SOME RESULTS OF EXPERIMENTS IN THE IONOSPHERE AND INTERPLANETARY SPACE MADE IN 1961–1962 ON GEOPHYSICAL ROCKETS OF THE USSR ACADEMY OF SCIENCES, THE COSMOS 2 SATELLITE AND THE MARS I SPACE PROBE
K. I. Gringauz *In* Intern. Sci. Radio Union (URSI), Brussels, Belgium Rept. on the 14th Gen. Assembly of the U.R.S.I. [1963] p 634–650 refs (See N64-30451 22-01)

This report reviews the following experiments: (1) the determination of electron concentration from measurements of radio-wave dispersion and of the Faraday effect by means of geophysical rockets; (2) the direct detection of an electric field in the ionosphere by means of an electrostatic fluxmeter mounted on rockets; (3) measurements of the structure of the ionosphere from the time of maximum solar activity, according to probe measurements on Cosmos II; and (4) plasma measurements by means of charged particle traps on the Mars I space probe. I.v.L.

N64-30453 Moscow State U. (USSR)
RESULTS FROM THE INVESTIGATIONS OF THE IONOSPHERE BY THE METHODS OF IMPULSE SOUNDING AND ARTIFICIAL SATELLITES
G. G. Getmantsev and N. G. Denisov *In* Intern. Sci. Radio Union (URSI), Brussels, Belgium Rept. on the 14th Gen. Assembly of the U.R.S.I. [1963] p 650–651 refs (See N64-30451 22-01)

This report contains a review of investigations carried out at Gorki and Moscow Universities from 1960 to 1963. These complex investigations made use of radio astronomy, impulse sounding, and artificial satellites. Topics discussed are as follows: (1) radio-wave absorption in the ionosphere; (2) small- and large-scale structural irregularities of the ionosphere; and (3) ionospheric investigations by experimental techniques on board satellites and rockets—various methods of measuring the electron concentration in the ionosphere. I.v.L.

N64-30467 Uppsala U. (Sweden) Geodetiska Inst.
SECULAR VARIATIONS IN THE LOWER HARMONICS OF THE EARTH'S GRAVITY FIELD DUE TO CONVECTION CURRENTS IN THE EARTH'S CORE
Andreas Vogel 1963 13 p refs *Its* Publ. No. 7

Deviation in travel time of PcP-, ScS-, PcS-, and ScP-waves are considered to be a consequence of different depths of reflection. Using this reflection data, a worldwide map for the distribution of the depth from the surface to the earth's outer core, for the epoch 1948 to 1954, is presented. A comparison of this map with a map for the current function for a thin spherical shell at a depth of 3,000 km within the earth (representing nondipole magnetic fields), for the epoch 1945, indicates a certain correlation. A comparison of the nondipole magnetic field with depths to the earth's core indicates a west drift in the nondipole magnetic field of about 0.2°/year. It has also been shown that changes in the rate of west drift of the nondipole are correlated to fluctuations in the earth's rotation. These correlations are explained in the following way. When the velocity of convection currents increase by rise of the temperature gradient, the west drift of the current system, with regard to the mantle, should then increase. At the same time, more heavy material is transported from the lower parts of the outer core to the upper parts, and consequently, as the angular momentum of the earth is constant, the rotation of the earth should decrease. Fluctuations in the rate of rotation of the earth indicate changes in the density distribution. Changes in the density distribution due to convection currents in the earth's core produce secular variations in the lower harmonics of the earth's gravity field. P.V.E.

N64-30511* Maryland U., College Park
ICE AGES
E. J. Opik Pergamon Repr. from The Planet Earth, 1964 32 p
(Grant NsG-58-60)

This single chapter from a book discusses astronomic chronology and palaeoclimatology in presenting theories concerning the formation of ice sheets, mountain glaciers, and surface ice on water. There are also sections on sea levels and isostasy, the Quaternary glacial epoch, and the cause of various ice ages. A.W.

N64-30520* Princeton U., N.J.
DEFORMATION OF A PURELY ELASTIC EARTH MODEL UNDER VARIOUS TECTONIC LOADS Technical Report No. 1
Bernard R. Durney 1 Apr. 1964 45 p refs
(Grant NsG-556)
(NASA-CR-56228) OTS: $2.00 fs; $0.50 mf

Stresses produced in the crust and mantle of the earth by irregularities of its density distribution or of its surface are evaluated. Examples of the types of stress that can be considered by the evaluation include those produced by mountains, by the deposition or evaporation of water from the poles, or by density differences giving rise to gravity anomalies. In the evaluation, the earth is considered as having an infinite depth. P.V.E.

N64-30546 Pennsylvania State U., University Park Ionosphere Research Lab.
TECHNIQUES FOR THE DETERMINATION OF REFLECTION COEFFICIENT AND VIRTUAL HEIGHT OF LOW FREQUENCY RADIO WAVES Scientific Report No. 214
C. P. Tou 20 Jul. 1964 56 p refs
(Contract AF 19(628)-4014, Grant NSF GP-846)
(AFCRL-64-611; AD-447109)

The reflection coefficients for different profiles of electron density, for radio waves vertically incident on an ionospheric layer, are calculated by an accurate full wave method. Group heights of reflection are also calculated by a full wave method, and the results are compared with those obtained by the zero-collision ray theory method. The errors produced by these two different methods are quite small for certain conditions. This implies that a zero-collision ray theory method of calculating the true heights of reflection can be used for low-frequency ionogram reduction. Author

N64-30565 Kiruna Geophysical Observatory (Sweden)
KIRUNA GEOPHYSICAL DATA Data Summary 63/3, Jul.–Sep. 1963
[1963] 77 p Sponsored by AF
(AD-602884)

"Kiruna Geophysical Data," a collection of results of measurements carried out at the Kiruna Geophysical Observatory, is presented. The objective of this data summary is to provide current geophysical data related to polar upper-atmosphere conditions. The coordinates of the observatory are 67.8° N 20.4° E geographically, and 65.3° N 115.5° E geomagnetically. Data obtained at the observatory, which are regularly published by other groups in Sweden, have not been included in this collection. I.v.L.

N64-30657 Smithsonian Astrophysical Observatory, Cambridge, Mass.
MEASURES OF THE EARTHSHINE
Gustav A. Bakos 14 Aug. 1964 59 p refs
(Grant NSF Y/8.11-236)
(SAO Special Rept.-162)

An attempt was made to correlate the brightness of the earthshine with worldwide weather data for 1958. Although no positive relation has been found, some problems in connection with the fluctuations of the brightness of the earthshine have been clarified, and the mean albedo of the earth has been computed. Author

N64-30711 California U., Berkeley Cosmic Ray Group
OBSERVATIONS ON THE RELATIONSHIP OF ENERGETIC PARTICLE PRECIPITATION TO AURORAL ZONE PHENOMENA
R. R. Brown and J. R. Barcus Jun. 1964 34 p refs
(Grants AF-AFOSR-62-422; AF-AFOSR-331-63)
(AFOSR-425; AD-254876)

Observational data obtained simultaneously from scintillation detectors and wideband photometers during a series of balloon flights made at Barrow, Alaska, in March 1963 are presented and discussed. Only a loose correlation was obtained between the appearance of X-rays at balloon altitudes and visual aurora at large L values. Ground-based riometer coverage plus simultaneous luminosity and X-ray measurements from the same balloon payload indicate that electrons $\geq$ 25 keV play an insignificant role in the production of auroral absorption during the quiet and breakup phases of a type of aurora frequently occurring at Barrow ($L \approx 8$). The appearance of energetic particle precipitation during a period of arrival of MHD waves, when both have similar time characteristics, indicates that the process responsible for this association, already established for lower L values, is still operative at $L = 8$. A number of intense and rather well isolated X-ray bursts lasting less than 1 second, observed during the latter stages of a geomagnetic storm, are discussed, as is the origin of a striking spectral variation observed during an unusually intense X-ray burst. Finally, it is noted that the time behavior, spectral character, and association with other geophysical phenomena of energetic electron precipitation are all strongly dependent upon local time, suggesting a daylight acceleration process and a local midnight untrapping mechanism. M.P.G.

N64-30765 National Physical Lab., New Delhi (India)
RADIO PROPAGATION UNIT PROGRESS REPORT 1961–63
[1963] 102 p refs

Progress is reported in the following areas of research: (1) "Ionospheric Physics—Vertical Incidence Sounding, Equatorial Ionosphere, Low Frequency Propagation"; (2) "Radio Propagation Service—Data Coordination, Sunspot Number Prediction, Ionospheric Prediction, Associate Regional Warning Center"; (3) "Aeronomy–D-Region Physics, Ionospheric Processes, Layer Formation, Ionospheric Dynamics"; (4) "Radioastronomy—Measurement of Cosmic Radio Noise, Scintillation of Radio Stars, Solar Radioastronomy"; (5) "Space Research—Atmospheric Densities, Satellite Radio Beacon Experiments for Ionospheric Research, Rocket Soundings of the Ionosphere"; and (6) "Interdisciplinary Studies—Radio Detection of Nuclear Explosions, Radio Patrol of Solar Flares." E.K.R.

N64-30772 Parametrics, Inc., Waltham, Mass.
RADIOLOGICAL MECHANISMS FOR GEOPHYSICAL RESEARCH Annual Report, Oct. 31, 1962–Oct. 31, 1963
Leonard L. Bird, John Papadopoulos, Roy A. Rex, and Charles A. Ziegler 31 Oct. 1963 69 p refs
(Contract AT(30-1)-2983)
(NYO-10220) OTS: $1.75

A study was conducted to determine the optimum design parameters for a radioisotope gage for measuring the suspended sediment concentration in rivers and streams. Flight data were obtained on the performance of balloon-borne beta-ray scattering gages for measuring atmospheric density. A model of the sediment gage was constructed and successfully flume tested at the Sedimentation Laboratory at Oxford, Mississippi, where sediment concentrations in the range from 500 ppm to 50,000 ppm were determined using various stream flow rates. The experimental results obtained and a theoretical analysis of gage performance are presented. Author

N64-30803* Alaska U., College Geophysical Inst.
HIGH LATITUDE GEOPHYSICAL DATA: 30 Mc/s COSMIC NOISE LEVEL Supplementary, Sep.–Dec. 1963
R. Parthasarathy 1 Jun. 1964 44 p
(Contract NAS5-3595)
(UAG-C-34)

The publication consists of reproductions of the cosmic radio noise level at 30 Mc/sec, monitored at College, Alaska (64.65° N, 256.56° E, geomagnetic). The zenith directed antenna is a pair of crossed, 3-element Yagis, responding to the noise in the right circular mode. The beam has approximate rotational symmetry, with about 60° between half-power points. The power linear receiver system is calibrated daily by a noise diode, in steps of 0, 2.0, 4.0, and 6.0 mA of the diode plate current. The variation of the noise level at College is primarily due to the variation of the precipitating auroral particles. Author

N64-30809 California U., San Diego Scripps Institution of Oceanography
EARTH-TO-SPACE CONTRAST TRANSMITTANCE MEASUREMENTS FROM GROUND STATIONS
Jacqueline I. Gordon, James L. Harris, and S. Q. Duntley Jan. 1963 27 p refs
(Contract NObs-84075)
(SIO-Ref.-63-2; AD-600909) OTS: $2.00

The ability of astronauts or satellite-borne cameras to see land masses, coast lines, or lesser objects on the surface of the earth depends upon the apparent contrast, C_r, of the object as viewed from orbital altitude. A method is described that is believed capable of providing input data for the apparent contrast equation given, on the basis of optical measurements made from ground stations. D.E.W.

N64-30833* Consultants and Designers, Inc., Arlington, Va.
DOES THE DURATION OF THE K-VARIATIONS EVOLVE AS A FUNCTION OF THE LATITUDE? [LA DUREE DES VARIATIONS K VARIE-T-ELLE EN FONCTION DE LA LATITUDE?]
Pierre-Noel Mayaud 3 Aug. 1964 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. Magnetisme Terrest. (Paris), v. 258, Group 10, 27 Apr. 1964 p 4311–4313
(Contract NAS5-3760)
(NASA-TT-F-8939; ST-GM-10185) OTS: $1.00 fs; $0.50 mf

Beginning with K-indices, measured over various time intervals in different observatories, it is shown that the average duration of the K-variations does not vary with the latitude. Author

N64-30838* Consultants and Designers, Inc., Arlington, Va.
INVESTIGATION OF THE IRREGULAR STRUCTURE OF THE IONOSPHERE ACCORDING TO RADIOOBSERVATIONS ON COSMOS-1, COSMOS-2, AND COSMOS-11 IN COHERENT FREQUENCIES [OB ISSLEDOVANII NEODNORODNOY STRUKTURY IONOSFERY PO REZUL'TATAM RADIO NABLYUDENIY ISZ "KOSMOS-1", "KOSMOS-2", I "KOSMOS-11" NA KOGERENTNYKH CHASTOTAKH]
E. E. Tsedilina and A. A. Kharybina 20 Aug. 1964 11 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 3, 1964 p 503–508
(Contract NAS5-3760)
(NASA-TT-F-8945; ST-RWP-10191) OTS: $1.00 fs; $0.50 mf

A spectrum W (ρ) of the dimensions of irregular ionosphere formations was obtained from measurements of the doppler shift of radiowave frequencies, emitted by satellites in coherent frequencies of 20.005 and 90.0225 mc/s. The spectrum W (ρ) has three unstable maxima at $\rho_1 \sim 14$ to 16, $\rho_2 \sim 28$ to 32, and $\rho_3 \sim 90$ to 110 km. The values ρ_1, ρ_2, and ρ_3 apparently are not dependent of the time of day or on the season. The investigation of the dependence W(ρ) on height has shown that the maximum number of irregular formations is observed at 50 to 100 km below the main maximum of the F2-region. The total number of irregularities decreases with the increase of height. Above 350 to 400 km the small-scale irregularities $\rho \sim 1$ km were not observed. Author

N64-30839* Consultants and Designers, Inc., Arlington, Va.
ON THE CONNECTION OF LIGHT SCATTERING IN THE FREE ATMOSPHERE WITH THE VERTICAL DISTRIBUTION OF AEROSOL PARTICLES' CONCENTRATION [O SVYAZI RASSEYANIYA SVETA V SVOBODNOY ATMOSFERE S VERIKAL'NYM RASPREDELENIYEM KONTSETRATSII CHASTITS AEROZOLEY]
A. G. Laktionov 26 Aug. 1964 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), no. 6, 1964 p 953–957
(Contract NAS5-3760)
(NASA-TT-F-8946; ST-AA-10192) OTS: $1.00 fs; $0.50 mf

The light scattering in the free atmosphere is composed of molecular scattering J_{zm} and aerosol scattering J_{za}. The intensity of molecular scattering decreases in height by the barometric formula, whereas the aerosol scattering does not submit to such regularity and can undergo significant variations. The aerosol scattering of a selected layer z is determined by the concentration and distribution by size of aerosol particles at a given level. Measurements of concentration and distribution by size of aerosol particles were conducted with the aid of a line (flow) photoelectric device and of a turbidimeter KOL-90, installed aboard an IL-14 aircraft. Author

N64-30840* Consultants and Designers, Inc., Arlington, Va.
SPATIAL DISTRIBUTION OF ANOMALOUS IONIZATION IN THE F2 LAYER AT HIGH LATITUDES [PROSTRANSTVENNOYE RASPREDELENIYE ANOMAL'NOY IONYZATSII V SLOYE F2 V VYSOKIKH SHIROTAKH]
L. A. Yubovich 27 Aug. 1964 14 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 3, 1964 p 518–523
(Contract NAS5-3760)
(NASA-TT-F-8947; ST-AI-10193) OTS: $1.00 fs; $0.50 mf

The spatial distribution of anomalous ionization in the F2 layer of the shadowed ionosphere is considered at stations of the Northern and Southern Hemispheres, as well as the influence of the anomalous ionization on f_0F2, conditioned by the ultraviolet radiation of the sun. The critical frequencies of the anomalous ionization reach greatest values at the geomagnetic latitude 82° to 87°. The space–time regularities of f_0F2 can be expalined within the framework of the magnetosphere-circulation theory, developed by Axford and Hines. The latitude distribution of ionization in the near midday hours during the period of winter solstice is subject to the regularity of the simple layer in the Northern as well as in the Southern Hemispheres. Author

N64-30843* Consultants and Designers, Inc., Arlington, Va.
FREE OSCILLATION FREQUENCIES OF THE EARTH'S ATMOSPHERE [CHASTOTY SVOBODNYKH KOLEBANIY ZEMNOY ATMOSFERY]
L. A. Dikiy 31 Aug. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), v. 157, no. 3, p 580–582
(Contract NAS5-3760)
(NASA-TT-F-8950; ST-AI-HD-10197) OTS: $1.00 fs, $0.50 mf

The frequencies of free oscillations of atmosphere on a rotating spherical earth are computed for real temperature stratifications, based on the standard atmosphere values (CIRA 1961). All types of oscillations, from waves of synoptic scale to fast acoustic waves, are incorporated in the obtained graph. M.P.G.

N64-30844* Consultants and Designers, Inc., Arlington, Va.
CONTRIBUTION TO THE STUDY OF SPORADIC E-LAYER MOVEMENTS [CONTRIBUTION A L'ETUDE DES MOUVEMENTS DES COUCHES E SPORADIQUES]
A. Spizzichino and C. Taieb 2 Sep. 1964 11 p refs Transl. into ENGLISH from Ann. Geophys. (Paris), v. 20, no. 2, 1964 p 197–200
(Contract NAS5-3760)
(NASA-TT-F-8951; ST-AI-10198) OTS: $1.00 fs; $0.50 mf

An ionospheric sounder made it possible to study systematically the vertical displacements of sporadic E-layers. A general downward movement of E_s-layers accompanies the increase in electron density. An interpretation of results is given in the light of recent theories that have been advanced for E_s. Author

N64-30851* Consultants and Designers, Inc., Arlington, Va.
MEASUREMENT OF ELECTRON CONCENTRATION IN THE IONOSPHERE BY OBSERVATIONS OF THE FARADAY EFFECT OF SIGNALS FROM EARTH'S ARTIFICIAL SATELLITES [IZMERENIYE ELEKTRONNOY KONTSETRATSII V IONOSFERE PO NABLYUDENIYAM EFFEKTA FARADEYA RADIOSIGNALOV ISZ]
E. E. Mityakova 16 Sep. 1964 11 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 4, 1964 p 668–674
(Contract NAS5-3760)
(NASA-TT-F-8958; ST-AI-RWP-10207) OTS: $1.00 fs; $0.50 mf

A method is worked out for analyzing the Faraday fadings of signals from satellites in a vertical column of unitary cross section. Calculation formulas and their limits of applicability are obtained. The results of processing of amplitude registrations of signals from Cosmos-1, Cosmos-2, and Explorer-VII are presented. Author

N64-30853* Consultants and Designers, Inc., Arlington, Va.
ABSORPTION OF CENTIMETER AND MILLIMETER RADIOWAVES BY ATMOSPHERIC WATER VAPOR [POGLOSHCHENIYE SANTIMETROVYKH I MILLIMETROVYKH RADIOVOLN ATMOSFERNYMI PARAMI VODY]
S. A. Zhevakin and A. P. Naumov 23 Sep. 1964 17 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 8, 1964 p 1327–1337
(Contract NAS5-3760)
(NASA-TT-F-8960; ST-AA-10209) OTS: $1.00 fs; $0.50 mf

Presented are the calculations of the absorption factors of radiowaves in the 0.7-mm to 32-cm band by water vapors contained in the atmosphere. The results are compared with the theoretical and experimental data of other authors. It is established that the application of the line shape obtained from the solution of the kinetic equation is in better agreement with the experiment than when that of Van Vleck–Weiskopf is utilized in the calculations. Author

N64-30877 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STUDY OF THE VELOCITIES OF LONGITUDINAL ELASTIC WAVES ON PERFORATED MODELS, SATURATED WITH LIQUIDS
G. I. Petkovich and T. Z. Verbitskiy 24 Jul. 1964 8 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 11, 1963 p 1470–1473
(FTD-TT-64-210/1+2; AD-603392) OTS: $1.00

The elastic properties of porous media that contain a liquid were studied. Porous materials (Duralumin, Plexiglass, and copper) with liquid fillers (distilled water, 20% NaCl solution, gas, etc.) were used as models of the media. Measurements were made by an impulse ultrasonic method with the aid of an intermediate-power-amplifier seismoscope operating at frequencies of 70 to 140 kc. The thickness of the models varied between 1.5 to 5 mm; the length was 15 to 20 cm; and the diameter no less than 10 cm. A triangular network of apertures was used, having parameters $h_1 = 8$ mm, $h_2 = 4$ mm, and $D = 2.5$ to 4 mm. A change in artificial porosity-perforation, from a minimum to 48%, was obtained by changing the diameter of the apertures. Measurements were made, basically, by the method of sounding. The method of longitudinal profiling was also tested. Time reading was made after the appearance of the wave, with inclusion of further phases. This assured an accuracy of rate designation of ±1.0% to 1.5%. I.v.L.

N64-30943 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry and Cartography
RESEARCH DIRECTED TOWARD A FEASIBILITY STUDY DEALING WITH THE INTEGRATION OF GRAVITY DATA Final Report No. 31
W. A. Heiskanen, Helmut Moritz, and Ivan I. Mueller Jun. 1964 31 p refs
(Contract AF 19(628)-1628)
(AFCRL-64-566(I); AD-605654)

This summary deals with the following individual papers: (1) Methods of Physical Geodesy; (2) A Review on Close Satellite Geodesy; (3) The Geodetic Applications of Satellites; (4) Satellite Perturbations Due to Zonal Gravitational Harmonics; and (5) On the Accuracy of Spherical Harmonics and Orbital Prediction. Author

N64-30944 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry, and Cartography
METHODS OF PHYSICAL GEODESY Report No. 32
W. A. Heiskanen and H. Moritz Jun. 1964 35 p refs *Its* Sci. Rept. no. 5
(Contract AF 19(628)-1628)
(AFCRL-64-566(II); AD-605655)

The following are discussed: (1) gravity measurements and gravity material; (2) gravimetric and astronomic measurements and astrogeodetic method; and (3) constants of the earth—equatorial radius, equatorial gravity, and harmonic coefficients of the earth's gravitational field. The flattening and normal figure of the earth and perturbing forces at satellite altitudes is also discussed. Author

N64-30946 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry and Cartography
THE GEODETIC APPLICATIONS OF SATELLITES Report No. 34
Ivan I. Mueller Jun. 1964 72 p refs *Its* Sci. Rept. no. 3
(Contract AF 19(628)-1628)
(AFCRL-64-566(IV); AD-605657)

The geodetic applications of satellites may be divided into geometric and dynamic applications. In the geometric applications, the general method is to compare the predicted position of the satellite, based on the assumed parameters of the orbit and the geocentric coordinates of the observer, with the observed positions. The comparisons, if made in sufficient numbers, may yield corrections to both the orbital elements and the coordinates of the observer, thus enabling simultaneous determinations of the orbit and the locations of the observers. In the dynamic applications, the coefficients of the spherical harmonic expansion of the earth's gravitational potential function are determined from observing the perturbations of the elements. From these directly determined coefficients, several indirect but geodetically significant results may be calculated, such as the shape of the earth ellipsoid, the regional undulations of the geoid, regional surface gravity anomalies, etc. Author

N64-30948 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry and Cartography
ON THE ACCURACY OF SPHERICAL HARMONICS AND ORBITAL PREDICTIONS Report No. 36

Helmut Moritz Jun. 1964 23 p refs *Its* Sci. Rept. no. 6
(Contract AF 19(628)-1628)
(AFCRL-64-566(VI); AD-605659)

The needed formulas for the gravity potential are derived, and the standard error of the obtained coefficients of spherical harmonics are obtained. Satellite orbits are influenced by the irregularities of the earth's gravity field, which are usually expressed in terms of a development in spherical harmonics. Thus we must know the gravity field, i.e., the coefficients of this development, for precise prediction of satellite orbits. These spherical harmonics coefficients can be determined either from the analysis of known satellite orbits or from gravity measurements at the surface of the earth. The accuracy of the orbital elements of the satellites computed from gravity anomalies, the determination of the gravimetric constant G M, and the position of the tracking stations are discussed. Author

N64-30983 California U., Berkeley Inst. of Engineering Research
ON CONVECTION IN A VISCOELASTIC PLASTIC MODEL OF THE EARTH'S CRUST AND MANTLE
Paul Lieber and Shrikant Desai May 1964 49 p refs
(Contract Nonr-222(87))
(MD-64-14(I); AD-605571)

It is concluded that if the mantle convects and if its mode of convection is Rayleigh–Benard, then it cannot be Voigt-like. Correspondingly, it is stated that if the mantle is essentially Maxwell-like in its macromechanical constitution, then it can admit Rayleigh–Benard convection and also support shear waves. D.E.W.

N64-31002* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
POPULATION POLYGONS OF TEKTITE SPECIFIC GRAVITY FOR VARIOUS LOCALITIES IN AUSTRALASIA
Dean R. Chapman, Howard K. Larson, and Leroy C. Scheiber Repr. from Geochim. Cosmochim. Acta, v. 28, no. 6, 1964 p 821–839 refs
(NASA-RP-299)

Measurements of specific gravity by the method of liquid flotation have been made on about 6,000 tektites from 18 different localities in Australasia, from 1 locality in Texas, and 2 in Czechoslovakia. Comparison of specific-gravity population polygons for various localities has led to the unanticipated conclusion that the australite population in southwest Australia is essentially the same as the philippinite population, rather than the population elsewhere in Australia. The javanite population appears closely related to certain populations in Australia. In several localities the presence of two superimposed populations is demonstrated. The specific-gravity evidence indicates that the Australasian tektites represent a single event comprising many distinguishable clusters, some of which have partially overlapped. Author

N64-31079 Joint Publications Research Service, Washington, D.C.
GEOGRAPHICAL AND CLIMATIC FACTORS AFFECTING THE REGIMES OF RIVERS OF THE USSR
Boris A. Apollov 23 Sep. 1964 159 p Transl. into ENGLISH of Selected Chapters of the book "Ucheniye O Rekakh" Moscow, Publ. House of Moscow U., 1963 423 p
(JPRS-26519; TT-64-41777) OTS: $3.00

Subjects of discussion include climatic and geographic factors in hydrometeorology and hydrology, atmospheric water vapor and condensation, evaporation, river-water temperatures, and river-ice phenomena. Detailed maps and tables are included. D.E.W.

N64-31127 Duntley (S.Q.), La Jolla, Calif.
MEASUREMENTS OF ATMOSPHERIC BOIL
S. Q. Duntley Sep. 1963 8 p
(Contract NObs-72039)
(Rept.-6-5; AD-600918) OTS: $1.00

The apparatus measured atmospheric boil in terms of its effect in limiting the resolving power of telescopes and tracking cameras. It was used in an experiment to explore the effect on measured rms ray deviation of increasing the entrance pupil diameter of the telescope beyond 6 inches. Curves plotted from the shimmer data are shown. R.L.K.

N64-31173 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
DERIVATION OF EQUATIONS FOR CONVERTING FROM GEODETIC COORDINATES TO GEOCENTRIC COORDINATES
F. T. Heuring Jul. 1963 21 p refs
(Contract NOw-62-0604-c)
(TG-511; AD-421546)

In the A.P.L. orbit computation programs, the TRANET Tracking Stations are specified in a geocentric coordinate system, whereas particular positions, such as a TRANET Tracking Site, over the earth are expressed initially in a geodetic coordinate system. In order to acquire geocentric coordinates from a given set of geodetic coordinates, a set of transformation equations were derived and are presented. The notation is defined, and the derivation of the equations is given. D.E.W.

N64-31188 Joint Publications Research Service, Washington, D.C.
RADIOACTIVE CONTAMINATION OF THE SEAS AND OCEANS
V. I. Barranov and L. M. Khitrov, ed. 20 Aug. 1964 113 p refs Transl. into ENGLISH of "Radioaktivnaya Zagryaznennost' Morey i Okeanov" Moscow, 1964
(JPRS-26002; TT-64-41273) OTS: $4.00

A collection of articles on the distribution of radioactive fission products in the oceans, their paths of entry and migration, methods of detecting them, and the role of marine organisms in the redistribution of radioisotopes is presented. Geochemical, biological, and hydrological aspects of the level of radioactive contamination of the oceans are discussed, and the radiation danger associated with fish and other marine food products is evaluated. M.P.G.

N64-31212* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DENSITY VARIATION AND ISOPYCNIC LAYERS
J. W. Smith Repr. from J. Appl. Meteorology, v. 3, no. 3, Jun. 1964 p 290–298 refs
(NASA-RP-334)

A pole-to-pole study of density deviations near the 80th meridian west, from the surface to 31 km altitude was undertaken. Density deviations are found to be greatest at the surface, and under extreme conditions may range from 1.0 to 2.0 kg m^{-3}. Density decreases almost exponentially with altitude and occasionally falls below 0.01 kg m^{-3} at 31 km. Density deviations decrease from the surface to an isopycnic layer, which varies in height from 6 km in polar regions to 12 km at the equator. Above this isopycnic layer, density variations increase with altitude to a maximum density deviation layer. This maximum density deviation layer occurs along the base of the summer tropopause and is approximately the center of the tropospheric wind maximum. The maximum density deviation layer

is parallel to, and 50% higher in altitude than the lower isopycnic layer. A weaker, second isopycnic layer is shown above and parallel to the maximum density deviation layer; this second isopycnic layer is found in tropical regions and near the South Pole. IAA

N64-31213* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEKTITES AND IMPACT FRAGMENTS FROM THE MOON
John A. O'Keefe Repr. from Sci. American, Feb. 1964 10 p refs
(NASA-RP-335)

A broad outline of evidence indicating a lunar origin for tektites is presented. The fact that tektites have a lunar origin is shown to indicate the following: (1) The moon has a hot interior and is differentiated into a crust and a mantle (although it has no molten core). (2) The moon is not a small planet "captured" by the earth but is either a chunk of primordial earth or a twin of the earth, formed at the same time from the same batch of materials. P.V.E.

N64-31218* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE IRON, MAGNESIUM, AND CALCIUM DISTRIBUTION IN COEXISTING OLIVINES AND RHOMBIC PYROXENES OF CHONDRITES
Klaus Kiel and Kurt Fredriksson (Calif. U.) Repr. from J. Geophys. Res., v. 69, no. 16, 15 Aug. 1964 p 3487–3515 refs
(NASA-RP-341)

Iron, magnesium, and calcium in olivines and pyroxenes of 95 chondritic meteorites were analyzed with an electron microprobe. Of these, 86 were "ordinary" chondrites, each having constant iron–magnesium ratios in olivine and pyroxene. Between different meteorites these ratios vary within three narrow ranges that reflect the H- and L-group chondrites, as well as a third group, designated the LL group. The ratio of iron in olivine to that in coexisting pyroxene is nearly constant (~1.1), particularly within the groups mentioned. A classification of stony meteorites based on the amount of iron in silicates and metal is proposed. It is shown that the iron content in the silicates is not related to the degree of metamorphism (recrystallization), and that therefore, the composition of the silicates was essentially established when the chondrules were formed. The ferrous iron also is not strictly related to the amount of metallic nickel–iron. Thus Prior's rule is not valid in its original sense, although it can be applied qualitatively when comparing the different groups of chondrites. Author

N64-31239* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ROCKET MEASUREMENT OF THE NITRIC OXIDE DAY-GLOW
Charles A. Barth Repr. from J. Geophys. Res., v. 69, no. 15, 1 Aug. 1964 p 3301–3303 refs
(Contract NAS7-100)
(JPL-TR-32-640)

A half-meter scanning ultraviolet spectrometer was flown on an Aerobee rocket to an altitude of 184 km. It scanned the day-glow spectrum from 1,500 to 3,200 Å. The rocket's altitude-control system aimed the spectrometer at the zenith during the ascent and at the horizon during the descent. Spectral scans of the ultraviolet day glow were obtained in the zenith direction in the altitude range from 76 to 114 km and also, with greatly increased intensity, during a scan of the horizon at 146 km. The most prominent features of these day-glow spectral scans were the gamma bands of nitric oxide. One spectrum obtained during the horizon scans is compared to a synthetic spectrum obtained from theoretical considerations. The measurement of the intensity of the 1 to 0 λ band at 2,155 Å permits the amount of nitric oxide present in the upper atmosphere to be determined; the column density of nitric oxide above the 88-km level was found to be 1.7×10^{14} molecules cm^{-2}. R.L.K.

N64-31266 Royal Inst. of Tech., Stockholm (Sweden)
ON A GENERAL WORLD GEODETIC SYSTEM
Arne Bjerhammar 30 May 1963 44 p refs
(Contract DA-91-591-EUC-2740)
(FTR-1; AD-420866)

To make this study, the Rudzky–Tengstrom method was used as a first step. Test models were designed, and direct numerical solutions were found for the application of the resolvent function for the vertical deflection in space developed by Bjerhammar. Different bodies were analyzed also, with exact Newtonian solutions as well as with the resolvent. A.W.

N64-31312 Joint Publications Research Service, Washington, D.C.
MORPHOLOGY OF THE MOHOROVICIC DISCONTINUITY AND ITS STRUCTURAL SIGNIFICANCE
A. A. Borisov 8 Oct. 1964 37 p refs Transl. into ENGLISH from Sovetskaya Geologiya (Moscow), no. 4, 1964 p 3–23
(JPRS-26802; TT-64-51059) OTS: $2.00

Seismometric data, the Mohorovicic discontinuity, and other subcrustal discontinuities are discussed at length. A map showing the relief of the Mohorovicic discontinuity beneath the territory of the U.S.S.R. is given. Extensive comments are made on the extreme range of depths of the discontinuity, on the great depths of the discontinuity beneath the interior of the Eurasian land mass, and on the two distinct types of discontinuity relief beneath territories of the U.S.S.R. These two types of relief are found beneath areas designated as orogenic or as platform regions, respectively. An extensive bibliography is included. D.E.W.

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-30351* ARA, Inc., West Covina, Calif.
THERMAL STRAIN ANALYSIS OF ADVANCED MANNED-SPACECRAFT HEAT SHIELDS First Monthly Progress Report, 19 Aug.–19 Sep. 1963
Daniel H. Platus 30 Sep. 1963 11 p
(Contract NAS9-1986)
(NASA-CR-54717; ARA-25) OTS: $1.00 fs; $0.50 mf

Progress is reported as follows: (1) The first phase of the study (derivation of basic equations) is proceeding on schedule and is 60% completed. The equilibrium equations in terms of displacements have been derived for the general nonaxisymmetric case for both spherical and toroidal coordinates, and the

equations for the spherical case have been reduced to the axisymmetric forms. The second phase of the study (finite difference formulation) is 6% completed. The general nonaxisymmetric forms of the finite difference analogs to the partial differential equations are being developed, from which a set of linear algebraic equations in the three displacement components will be obtained. The general forms of the finite difference approximations, with respect to three independent variables, are being calculated by expanding the displacement functions in power series in the neighborhood of the point under consideration, using unequal increments in each of the three principal directions. I.v.L.

N64-30352* ARA, Inc., West Covina, Calif.
THERMAL STRAIN ANALYSIS OF ADVANCED MANNED-SPACECRAFT HEAT SHIELDS Second Monthly Progress Report, 19 Sep.–26 Oct. 1963
Daniel H. Platus and Shoichi Uchiyama [1963] 25 p
(Contract NAS9-1986)
(NASA-CR-54718; ARA-27) OTS: $1.00 fs; $0.50 mf

The phase of study that constitutes the derivation of the basic equilibrium and stress equations, in spherical and toroidal coordinates, is 95% completed. The only portion not included in this report consists of defining certain coefficients in the equilibrium and stress equations that become singular on the axis of symmetry in the nonaxisymmetric case. However, an analytical method has been developed for treating the singularity. All of the finite-difference analogs to the partial differential equations have been derived for the general, nonaxisymmetric case and are presented. This constitutes 50% of the total effort for this phase. I.v.L.

N64-30353* ARA, Inc., West Covina, Calif.
THERMAL STRAIN ANALYSIS OF ADVANCED MANNED-SPACECRAFT HEAT SHIELDS Third Monthly Progress Report, 26 Oct.–29 Nov. 1963
Daniel H. Platus and Shoichi Uchiyama [1963] 21 p refs
(Contract NAS9-1986)
(NASA-CR-54721; ARA-30) OTS: $1.00 fs; $0.50 mf

The current program status includes the following: (1) The derivation-of-basic-equations phase was extended to include an investigation of the singularity that arises on the axis of symmetry in the nonaxisymmetric case. Results of this study, which completes this particular phase of the program, are summarized in Appendix 1 of this report. It was concluded that points on the axis of symmetry could be considered in the nonaxisymmetric case, but that the additional programing required and the complication introduced probably would not justify the improved accuracy to be gained. Certain regions of the heat-shield structure consist of extremely thin layers that, by themselves, can satisfy the usual thin-shell criteria. It becomes necessary to treat these thin layers in a manner that precludes subdividing them into thinner layers. This can be accomplished by treating each layer by the thin-shell theory. The stress and strain distributions throughout the shell thickness are obtained by using the Kirchhoff bending hypothesis for thin shells. This method is summarized for a plate using Cartesian coordinates in Appendix 2. I.v.L.

N64-30354* ARA, Inc., West Covina, Calif.
THERMAL STRAIN ANALYSIS OF ADVANCED MANNED-SPACECRAFT HEAT SHIELDS Fourth Monthly Progress Report, 30 Nov. 1963–6 Jan. 1964
Daniel H. Platus and Shoichi Uchiyama [1964] 21 p
(Contract NAS9-1986)
(NASA-CR-54720; ARA-33) OTS: $1.00 fs; $0.50 mf

The current program status includes the following: (1) All boundary and interface conditions that will be required in the thin-shell analysis are described and formulated in Appendix 1. In the case of the thin-shell interface conditions, the equations are formulated in general terms, pending the completion of the investigation of engineering models. (2) A method was presented, in a previous report, for treating the stresses and displacements in thin layers of the composite heat shield that, if treated by the usual three-dimensional theory, would yield difficulties in the numerical evaluation. This method was summarized in Cartesian coordinates, for simplicity, to demonstrate the basic assumptions and boundary conditions. This analysis is presently being extended to the spherical and toroidal coordinate systems pertinent to the heat-shield geometry. In this report, the derivation is partially summarized for the spherical coordinate system in Appendix 2. I.v.L.

N64-30355* ARA, Inc., West Covina, Calif.
THERMAL STRAIN ANALYSIS OF ADVANCED MANNED-SPACECRAFT HEAT SHIELDS Fifth Monthly Progress Report, 6 Jan.–30 Jan. 1964
Daniel H. Platus and Shoichi Uchiyama [1964] 40 p
(Contract NAS9-1986)
(NASA-CR-54719; ARA-37) OTS: $2.00 fs; $0.50 mf

A summary of work carried out in the following phases of the program is presented: (1) formulation of boundary conditions; (2) investigation of engineering models; and (3) reduction of equilibrium equations in spherical coordinates to axially symmetric cases and the formulation of sample problems. P.V.E.

N64-30363 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AN APPRAISAL OF THE ROLE OF RADIATION WHEN CALCULATING HEAT EXCHANGE IN A TURBULENT BOUNDARY LAYER
S. S. Kutateladze, A. I. Leont'yev, and N. A. Rubtsov *In its* J. of Appl. Mech. and Tech. Phys., 17 Jun. 1964 9 p refs (See N64-30361 22-11) OTS: $1.00

Radiation introduces into the process of heat exchange both a direct and an indirect contribution. The latter is determined by the influence of radiation on the temperature field and, consequently, even on the processes of heat transfer by thermal capacity and convection. An appraisal is given of the role of radiation during the calculation of heat exchange in the turbulent boundary layer of a high-temperature gas. The relative ultimate laws of heat exchange and friction of the turbulent boundary layer of a compressible liquid are used. Author

N64-30418 Joint Publications Research Service, Washington, D.C.
INTEGRAL EQUATIONS FOR THE PROBLEM OF THE IRREGULAR FUSION OF GLASSY MATERIALS
E. M. Shakhov *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 10–14 refs (See N64-30416 22-33) OTS: $4.00

The one-dimensional nonstationary problem of the fusion of the glassy covering located in the front part of a blunt body subjected to aerodynamic heating is examined. Some simplifying assumptions in the system of differential equations for irregular fusion in the glassy material can lead to a system of integral equations similar to those of the classical problem of Stephan. Author

N64-30594 Naval Ordnance Lab., White Oak, Md.
A CRITICAL CONDITION IN TIME-DEPENDENT THERMAL EXPLOSION THEORY

Julius W. Enig Oct. 1964 18 p refs
(NOLTR-63-282; AD-447155)

A criterion defining the explosion time as a function of initial temperature T_0 and surface temperature T_s has been derived from an approximate solution of the heat-conduction equation for the semi-infinite explosive $x > 0$, initially at T_0 and with surface temperature maintained at T_s. The chemical reaction is assumed to follow zero-order kinetics. For different values of T_0 and T_s, the derived explosion times are compared with those previously calculated from numerical solutions, and the agreement is found to be satisfactory. Author

N64-30632 Arde-Portland, Inc., Paramus, N.J.
COOLED SOLID PROPELLANT ROCKET NOZZLES, VOLUME II Final Report
Sidney Elkind 15 Jun. 1964 81 p refs
(Contract DA-30-069-ORD-3099)
(A-PFR-5601; AD-602806)

A study was made to evaluate the potential of the liquid metal lithium as a coolant for solid propellant rocket nozzles. The program plan included the analysis, design, and testing of two cooling systems—convection and spray film. A literature survey was made to review the state-of-the-art of rocket nozzle cooling. Author

N64-30816 Brown U., Providence, R.I.
VORTICITY AMPLIFICATION IN STAGNATION-POINT FLOW AND ITS EFFECT ON HEAT TRANSFER
S. P. Sutera Wright-Patterson AFB, Ohio, ARL, Jun. 1964 55 p refs
(Contract AF 33(616)-7749)
(ARL-64-91; AD-603503) OTS: $3.00

Recently a mathematical model was proposed (Sutera, Maeder, and Kestin) to demonstrate that vorticity amplification by stretching was an important mechanism underlying the sensitivity of stagnation-point heat transfer on cylinders to free-stream turbulence. According to the model, vorticity of a scale larger than a certain neutral scale and appropriately oriented can undergo amplification as it is convected toward the boundary layer. In this work a second, more general, case is treated in which the approaching flow carries vorticity of scale 1.5 times the neutral. By means of iterative procedures applied on an electronic analog computer, an approximate solution to the full Navier–Stokes equation is generated. The heat-transfer problem is solved simultaneously for Pr = 0.70, 7.0, and 100. Author

N64-30919 Stanford U., Calif.
HEAT TRANSFER AND FLOW FRICTION CHARACTERISTICS OF SKEWED AND GLASS-CERAMIC HEAT TRANSFER SURFACES
C. P. Howard Oct. 1963 52 p refs
(Contract Nonr-225(23))
(TR-59)

Experimental results for convective heat transfer and flow friction characteristics of three skewed passage and four glass–ceramic compact heat-exchanger surfaces are presented, which should be of practical use, particularly in the design of gas turbine regenerators. The heat-transfer data were obtained by the transient technique. Author

N64-30932 Purdue U., Lafayette, Ind.
TABLES OF THERMOPHYSICAL PROPERTIES OF MATERIALS Final Report, 15 Oct. 1962–31 Dec. 1963
Y. S. Touloukian Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 31 p
(Contract AF 33(657)-10545)
(ML-TDR-64-184; AD-605411)

This report covers work in a continuing systematic program involving the search, collection, extraction, evaluation, correlation, interpolation, extrapolation, and the final preparation of tables of properties referred to as "most probable" values. It includes the thermal conductivity and viscosity of gases and liquids, the thermal conductivity of metallic and nonmetallic elements, their alloys and compounds, and the emissive properties of metals. Author

N64-31018 Canadian Armament Research and Development Establishment, Valcartier
HEAT TRANSFER TO SPHERES AND CONES IN EQUILIBRIUM AIR
D. Heckman Aug. 1964 69 p refs
(ARPA Order 133)
(CARDE-TR-479/64)

This report tabulates the results of numerical calculations of heat-transfer rates on spheres and cones using the various theoretical correlations that have been developed to represent heat transfer about bodies with attached laminar flow. The calculations were performed assuming air in thermodynamic equilibrium for a set of body sizes, ambient conditions, and velocities appropriate to the hypersonic range programs in progress. Author

N64-31057 California U., Livermore Lawrence Radiation Lab.
NOTE CONCERNING AN ELECTRICAL HEATER ERROR IN THE ROCKING-BOMB SOLUTION CALORIMETERS
Stuart R. Gunn 29 Jul. 1964 11 p refs
(Contract W-7405-ENG-48)
(UCRL-7992) OTS: $0.50

This note describes an error that has been found in calibration of the rocking-bomb solution calorimeters, due to local surface superheating in the region of the heater, and an estimate of corrections to be applied to previously published data taken with these calorimeters. Author

N64-31208* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
MONTE CARLO SOLUTION OF RADIANT HEAT TRANSFER IN A NONGREY NONISOTHERMAL GAS WITH TEMPERATURE DEPENDENT PROPERTIES
John R. Howell and Morris Perlmutter Repr. from AIChE Journal, v. 10, no. 4, Jul. 1964 p 562–567 refs Presented at San Juan Meeting of AIChE
(NASA-RP-317)

The radiant-energy transfer and the temperature distribution are found for a nongrey nonisothermal gas between infinite parallel walls. Only the case of black walls is treated. Two solutions are obtained—one for walls at unequal temperatures and with no heat sources in the gas, and the other for both walls at the same temperature and with a parabolic distribution of heat sources in the gas. The results indicate that for gases with large optical thickness, diffusion approximations modified for the temperature-dependent absorption coefficient are applicable. In the opposite case, transparent solutions are applicable. The Monte Carlo method is flexible enough to move most assumptions involving the diffusion or transparency of the investigated gas, and can be modified to include other effects, such as scattering, nongrey, and/or nondiffuse walls, etc. P.V.E.

N64-31210* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECTS OF REDUCED GRAVITY ON NUCLEATE BOILING BUBBLE DYNAMICS IN SATURATED WATER
R. Siegel and E. G. Keshock Repr. from AIChE Journal, v. 10, no. 4, Jul. 1964 p 509–517 refs Presented at San Juan Meeting of AIChE
(NASA-RP-320)

The nucleation occurred on a very smooth horizontal nickel surface at low heat fluxes. Since, because of the smooth surface finish, only a few nucleation sites were active, it was possible to photograph individual bubbles that were not interfered with by adjacent bubble columns. Data were taken at seven different gravity fields in the range from 1.4% to 100% of earth gravity by placing the apparatus on a counterweighted falling platform. Measurements were made of bubble departure diameters and frequencies, growth rates, contact angles, base circle diameters, and rise velocities. Comparisons were made to determine whether the measured gravity dependence of these quantities was in agreement with that predicted by correlations in the literature. IAA

N64-31241 Boeing Co., Seattle, Wash.
LEADING EDGES DEVELOPMENT—DYNA SOAR, MODEL X-20A, VOLUME III
D. A. Bowers [1963] 290 p
(Contract AF 33(657)-7132)
(D2-80085; AD-421685)

Thermal gradient and loads test data are presented as tables for the following categories: temperature, pressure load vs deflection, pressure load vs maximum shear stress, rapid load vs deflection, and slow load vs deflection. Curves are presented for rapid load vs time. E.K.R.

N64-31242 New York U., N.Y. Geophysical Sciences Lab.
A LINEAR LAGRANGIAN MODEL OF TURBULENT HEAT CONDUCTION AND CONVECTION (I)
Willard J. Pierson, Jr. Jun. 1963 27 p refs
(Contract Nonr-285(03))
(Geophys. Sci. Lab. Rept.-63-8; AD-421586)

Using the Eulerian form of the Navier Stokes equations as the starting point, the author transforms them into a Lagrangian form and simultaneously linearizes them by means of a perturbation expansion about the rest solution that consists of a linear temperature gradient and no motion. A linearized system of equations is obtained that is more or less equivalent to the Boussinesq approximation. A fundamental solution to these equations is then found, and the superposition of a number of such solutions yields a motion satisfying appropriate boundary conditions at the bottom and top plates. Though linear, the solution thus obtained is exceptionally complex and is not evaluated in the paper, but ways to evaluate it are described. A.W.

N64-31268 Solar, San Diego, Calif. Aerospace Div.
DEVELOPMENT OF MANUFACTURING METHODS FOR LIGHTWEIGHT METAL FOIL HEAT EXCHANGERS Interim Technical Report, 18 Jun.–17 Sep. 1963
J. P. Boland, L. A. Schlager, and S. Alpert 2 Oct. 1963 53 p
(Contract AF 33(657)-8766)
(ITR-5; AD-421472)

The reporting period covers work performed in the fabrication and testing of the hydrogen precooler and the pre-precooler. Analytical work performed was an optimization study of the hydrogen precooler, for which a program was written for the IBM-7090 computer, breaking the heat exchanger down into a number of segments in series. An outline of a proposed structural test program is also given. A.W.

N64-31280 Massachusetts Inst. of Tech., Cambridge
THE PREDICTION OF LOW QUALITY BOILING VOIDS Technical Report No. 23
Peter Griffith Jan. 1963 37 p refs
(Contract Nonr-184139)
(Rept.-7-7673-23; AD-404711)

Slug flow theory is used to predict the density in heated channels of various shapes. In order to make this calculation possible, measurements are made of the bubble rise velocity in annuli, tube bundles, and channels. It is found that the large dimension is most important in channels and the shroud dimension most important in annuli and tube bundles. It is also found that no rotationally symmetrical bubble shapes are obtained in annuli and tube bundles. A comparison is made between the theory, which contains no free constants, and the experiments. The comparison is good. The results, as presented, apply only to vertical heated channels of various shapes with upflow in the low-quality region. Author

N64-31326 Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
LAMINAR FREE CONVECTION FROM A HORIZONTAL CYLINDER WITH PRESCRIBED SURFACE HEAT FLUX Mathematical Note No. 314
J. C. Y. Koh and J. F. Price Aug. 1963 29 p refs
(DI-82-0282; AD-420095)

Laminar free convection from a horizontal cylinder having a prescribed surface heat flux is analyzed. The wall surface heat flux is assumed to be varied in the manner of $a_1(x/R)^2 + a_2(x/R)^4$. Special transformations are devised and employed so that the resulting differential equations and boundary conditions are free of the parameters a_1 and a_2. These differential equations are solved once and for all; solutions to the original equations for any particular values of a_1 and a_2 may then be obtained easily as linear combinations of the numerical solutions. It is found that the average Nusselt number for a cylinder having a uniform surface heat flux is larger than that for a cylinder having an isothermal surface by no more than 4%. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-30219 Joint Publications Research Service, Washington, D.C.
THE USE OF LOGICAL DIAGRAMMING IN THE PLANNING AND ORGANIZATION OF THE TRAINING PROCESS
A. A. Ovchinnikov and V. S. Puginskiy *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 109–119 ref (See N64-30207 22-01) OTS: $6.00

Some methods are considered for the rational planning of the training process based on the use of logical diagram; possibilities are discovered for the use of logical diagrams for improvement of organization of the learning process. Author

N64-30321 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS FROM VOPROSY PSIKHOLOGII (PROBLEMS OF PSYCHOLOGY), NO. 3, 1963

20 Aug. 1964 72 p refs Transl. into ENGLISH of selected articles from Vopr. Psikhologii (Moscow), no. 3, 1963 (JPRS-26014; TT-64-41284) OTS: $3.00

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N64-30322 Joint Publications Research Service, Washington, D.C.

APPARATUS FOR RECORDING MOTOR AND SENSORY ACTS OF THE OPERATOR IN AUTOMATIC AND SEMIAUTOMATIC CONTROL SYSTEMS

Ye. S. Zav'yalov, A. P. Kuz'minov, and V. I. Mankevich *In its* Transl. from Vopr. Psikhologii (Probl. of Psychol.), No. 3, 1963 p 1–6 (See N64-30321 22-14) OTS: $3.00

An apparatus for recording the activity of an operator working at a control system is described. The apparatus works automatically and performs the following operations: It starts up an electrostopwatch with the end of a command phrase by an experimenter, and stops it with the beginning of a spoken answer to a given command, or after the operator fulfills an answering motor action. Using a pulse camera that works synchronously with control impulses of a signal exciter, it records on picture frames the time reading of the electrostopwatch, the readings of the indicators, the position of the signaling apparatus and of control levers on the test panel in the initial and final state. Using a tape recorder, it records the content of any spoken assignments to the operator, as well as his answers. P.V.E.

N64-30323 Joint Publications Research Service, Washington, D.C.

EXPERIMENTAL METHODS: AN EXPERIMENTAL APPARATUS FOR STUDYING THE INFLUENCE OF VARIOUS VISUAL SIGNALLING PARAMETERS ON THE EFFECTIVENESS OF MOTOR REACTIONS

V. N. Antonov, V. V. Lepeshkin, and A. Ye. Ol'shannikova *In its* Transl. from Vopr. Psikhologii (Probl. of Psychol.), No. 3, 1963 p 7–11 (See N64-30321 22-14) OTS: $3.00

An apparatus is described that is intended for the following purposes: (1) a study of the dependency of time of motor reactions upon the intensity of visual stimulants under different conditions, comparable with industrial ones; and (2) a study of the relationship between time characteristics of motor reactions (magnitude of time of reaction, its duration, etc.) and their other quantitative characteristics (degree of intensity of pressure on push button, form of curve of pressure, etc.). P.V.E.

N64-30324 Joint Publications Research Service, Washington, D.C.

DISCUSSIONS AND CONSIDERATIONS: IS AN "ALGORITHMIC" APPROACH TO THE ANALYSIS OF LEARNING PROCESSES VALID?

N. G. Alekseyev *In its* Transl. from Vopr. Psikhologii (Probl. of Psychol.), No. 3, 1963 p 12–24 refs (See N64-30321 22-14) OTS: $3.00

The assumption that learning algorithms leads not only to mastering the solution of certain definite problems but also to mastering general methods of thinking is critically analyzed. Questions considered include the basic positions of the concept of algorithms, the implementation of algorithms in the practice of learning, and the relationship of algorithms to the theory of mastering thinking activity. P.V.E.

N64-30325 Joint Publications Research Service, Washington, D.C.

CORTICAL CONTROL OF EYE MOVEMENTS (ROLE OF PRE-MOTOR SECTIONS OF THE BRAIN IN CONTROL OF EYE MOVEMENTS)

Ye. D. Khomskaya *In its* Transl. from Vopr. Psikhologii (Probl. of Psychol.), No. 3, 1963 p 46–59 refs (See N64-30321 22-14) OTS: $3.00

Twelve patients with lesions of premotor sections of the brain were examined. The focus of the lesion was in the left premotor zone of 10 patients, and in 2 patients it was in the right zone. It was found that experimental data obtained from patients with lesions of premotor sections of the brain differ essentially from results of examinations of healthy individuals. Eye movements of a majority of the patients with lesion of the premotor area of the brain were characterized by de-automatization criteria: absence of standardness, of rhythmicality (in one series of tests), and of smoothness (in another series of tests). The data presented indicate that the front cortical eye-motor center has a preferential relation with those forms of eye-movement control that are carried out on the basis of the system of speech connections, and is, to a smaller degree, connected with forms of eye-movement control conditioned by visual afferent factors. P.V.E.

N64-30466 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

SUBJECTIVE COMPARISON OF SONIC BOOMS WITH OTHER AIRCRAFT NOISE Technical Memorandum, 1 Dec. 1963–1 Mar. 1964

[1964] 2 p

Results are reported of tests for determining the startle effects produced in human beings by unexpected sonic booms in a control group and a noncontrol group, both of which experienced soothing music throughout the testing. Other tests are described in which subjects tried to distinguish between an octave band of pure noise and the same noise plus a pure tone at the center frequency. Conditions and experimental details are reported, and planned future work is described. D.E.W.

N64-30491 Tufts U., Medford, Mass.
THE ROLE OF THE PINNA IN HUMAN LOCALIZATION
Dwight W. Batteau Jan. 1964 31 p refs
(Contract N123(60530)-32279A)
(AD-600151) OTS: $2.60

In theory, the role of the pinna in localization is to introduce, by means of delay paths, a transformation of the incoming signal, which is mentally inverted to provide attention; the inverse transform required defines the location of the sound source. Relatively simple systems of delays, attenuations, and signed additions may be used to construct the inverse transformations; these could easily be realized in the nervous system. It may be further theorized that the same method of constructing inverse transformations can apply to monaural and binaural localization, sound recognition, and the utilization of reverberation. Author

N64-30499 Cincinnati U., Ohio
A COMPARISON OF MODES OF PRESENTATION OF PAIRED-ASSOCIATES ON THE SUBJECT-MATTER TRAINER
Alfred B. Kristofferson, John A. Modrick, and Ross L. Morgan
Wright-Patterson AFB, Ohio, AMRL, Jun. 1963 19 p refs
(Contract AF 33(616)-7674)
(AD-439648) OTS: $1.60

An experiment was conducted to evaluate the effectiveness of each of four modes of the Subject-Matter trainer. The modes were these: (1) the Quiz Mode, in which the subject was shown sequentially the correct response following the presentation of each stimulus; (2) the Modified-Quiz Mode, in which the subject was allowed one free choice before being shown the correct response; (3) the Practice Mode, in which the subject responded freely until he found the correct response; and (4) the Single-Try Mode, in which the subject was allowed only one response to each stimulus. Four groups of 24 subjects each were used. Each group learned under a different mode of the Subject-Matter trainer. Each subject learned 20 paired adjectives to a criterion of two successive, completely correct trials. Retention was measured after 1 day and after 7 days. The Quiz Mode was superior to the other modes, all of which involved active participation and some degree of feedback. Retention after 1 day was almost perfect for all groups. The amount retained after 7 days did not differ significantly among the groups. Author

N64-30500 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
BIBLIOGRAPHY ON MAINTENANCE PERSONNEL PERFORMANCE MEASUREMENT
William B. Askren, Jr. Jun. 1963 23 p refs
(AMRL-Memo-P-45; AD-439610) OTS: $2.60

N64-30646 Army Personnel Research Office, Washington, D.C.
INFORMATION ASSIMILATION FROM ALPHA-NUMERIC DISPLAYS—AMOUNT AND DENSITY OF INFORMATION PRESENTED Technical Research Note 141
Seymour Ringel and Charles Hammer Apr. 1964 27 p refs
(AD-601973) OTS: $0.75

Thirty subjects were required to extract specific items of information from slide-projected displays of varying amounts and densities. Results were as follows: (1) As total amount of information presented increased from 10 to 25 lines, mean search time increased approximately 4 sec (an increase of approximately 24%). (2) Pertinent information near the bottom of the displays took approximately 4 sec longer to find than information near the top (a difference of approximately 22%). (3) When the number of columns to be searched was increased from two to four, search time increased 6 sec per added column (a total time increase of 100%). (4) Search time for high density of information was slightly shorter than for medium and low densities. (5) Accuracy was high under all conditions of search. Author

N64-30718 School of Aerospace Medicine, Brooks AFB, Tex.
CREW STRUCTURE IN FUTURE SPACE MISSIONS
Bryce O. Hartman and Don E. Flinn *In its* Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 50–72 refs (See N64-30712 22-16)

Experimentation during simulated flights as well as actual aircrew experience indicates that despite minor irritations, well-motivated crew members are capable of suppressing antagonistic feelings in the interest of mission completion, and continue to function without an adverse effect upon performance. Although interpersonal problems may occur in small crews as mission time is extended, it appears likely that any such problems will not be of major magnitude, and that there are no grounds for predicting that they will reduce crew effectiveness. As crews become larger, even brief missions may result in interpersonal problems. Clearly defined vocational roles and crew structure will become increasingly important as crews become larger. There will always be a "pilot" and it seems logical that he will be the leader of the crew. A review of anecdotal material regarding behavior during disasters and catastrophes reveals that here is a potential in groups for nonadaptive behavior. Author

N64-30720 School of Aerospace Medicine, Brooks AFB, Tex.
MILITARY ASPECTS OF SATELLITE-TO-EARTH VISIBILITY
William B. Clark, Floyd M. Morris, and James F. Culver *In its* Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 93–99 refs (See N64-30712 22-16)

An ordinary man only very rarely utilizes his maximal visual capability. He would therefore not be likely to see as much as an astronaut who, because of his prior flying experience and his training, has become accustomed to the utilization of his maximum visual capability. Thus, in spite of the belief that extravehicular vision would contribute little, the Mercury astronauts proved that the application of intelligent interpretation to the available clues can "resolve" fantastically small visual targets. They have proven that military reconnaissance is possible with unaided eyes. Author

N64-30721 Indiana U., Bloomington
SATELLITE-TO-SATELLITE VISIBILITY
Ingeborg Schmidt *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 100–118 refs (See N64-30712 22-16)

With an increasing number of orbiting satellites and in view of future rendezvous maneuvers in space, the problem of the visibility of a space vehicle from another space vehicle deserves special attention. The main visual functions involved are discussed and an attempt is made, on the basis of laboratory findings, to predict the visibility of a satellite in typical situations. Most laboratory findings are obtained at fairly short distances. When applying these results to vision in space, the assumption is made that the same visual mechanisms mediate perception. For simplification, the analysis is confined to orbital flights around earth and does not include the phases of takeoff and reentry with their special visual problems. The terminal phase in a rendezvous is also not considered. It is assumed that one single satellite serves as the visual target. Author

N64-30722 School of Aerospace Medicine, Brooks AFB, Tex.
AEROMEDICAL EVALUATION OF SPACE PILOTS
Lawrence E. Lamb *In its* Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 119–142 (See N64-30712 22-16)

Aeromedical evaluations differ from those obtained from hospitals and clinics in that the former are based on the early detection of disease in the asymptomatic individual rather than, as in the latter, on data from the ill and ailing. In the development of space medicine, Navy diagnostic techniques and procedures have been originated or improved. Aeromedical evaluation consists of aeromedical history, physical examination, laboratory examination, radiology evaluation, otorhinolaryngology evaluation, ophthalmology evaluation, neurological evaluation, psychiatric and psychological evaluation, pulmonary evaluation, and cardiovascular evaluation. A.W.

N64-30831* Serendipity Associates, Los Angeles, Calif.
UTILIZATION OF ACCEPTANCE DATA IN A DESCRIPTIVE MODEL FOR DETERMINING MAN'S ROLE IN A SYSTEM
Harold E. Price, Ewart E. Smith, and Richard A. Behan Washington, NASA, Sep. 1964 171 p refs
(Contract NAS2-1346)
(NASA-CR-95) OTS: $3.00

This report contains the following information for use in the design of man–machine systems. (1) A partial descriptive model of the system development processes is presented for use in determining if man should be a system component, and if so what his optimal role and location should be. The model is presented in functional-flow logic. (2) The problem of system inefficiency due to nonacceptance by man of his role is analyzed. Principles for avoiding acceptance problems are described, as well as methods for measuring acceptance factors. (3) Some of the data on human capabilities and limitations is presented in a manner consistent with the model utilization and the requirements-oriented system designer. Author

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-30230 Joint Publications Research Service, Washington, D.C.
BI-AXIAL GYROSTABILIZED PLATFORMS ON A MOBIL BASE
N. T. Kuzovkov *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 249–260 refs (See N64-30207 22-01) OTS: $6.00

It is shown that a biaxial gyrostabilized platform made up of four pairs of related gyroscopes, from the point of view of stability, does not have significant advantages over a platform made up of two gyroscopes. However, from the point of view of decrease of amplitude of the forced oscillations determined by the rocking of the base, a four-gyroscope platform is preferable. Author

N64-30232 Brookhaven National Lab., Upton, N.Y.
REPORT ON THE LOGICAL DESCRIPTION OF THE FILM PRESELECTOR SYSTEM FOR THE SPARK CHAMBER READER
G. Schwender, D. Engelberg, R. Schuman, and R. Squires Jun. 1964 27 p
(BNL-876(T-352)) OTS: $0.75

The preselector reader is a device to read and store data contained on punched tape, to cause the spark-chamber reader to search for a particular frame and, when located, cause it to be digitized or indicate an error condition if the particular frame cannot be found. The reader consists of three DEC bins containing logic cards and a Rheem paper-tape reader. The paper describes how the preselector reader performs. A.W.

N64-30364 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEWS OF THE ACADEMY OF SCIENCES OF THE USSR. TECHNOLOGY SECTION. MECHANICS AND MACHINE BUILDING Selected Articles
3 Jun. 1964 21 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekh. Nauk: Mekh. i Mashinostr. (Moscow), no. 2, 1963 p 120–125, 133–135
(FTD-TT-64-414/1+2+4; AD-601522) OTS: $1.75

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1. SOME PROBLEMS IN THE MOTION AND STABILITY OF A SPHERICAL GYROSCOPE V. V. Krementulo p 1–12 refs (See N64-30365 22-15)
2. INFLUENCE OF CENTRIFUGAL MOMENTS OF INERTIA OF THE INNER GIMBAL OF A CARDAN SUSPENSION ON GYROSCOPE STABILITY I. N. Sinitsyn p 13–18 refs (See N64-30366 22-15)

N64-30365 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SOME PROBLEMS IN THE MOTION AND STABILITY OF A SPHERICAL GYROSCOPE
V. V. Krementulo *In its* News of the Acad. of Sci. of the USSR. Technol. Section. Mech. and Machine Bldg. 3 Jun. 1964 p 1–12 refs (See N64-30364 22-15) OTS: $1.75

Various approaches are suggested for studying the motion and stability of a spherical gyroscope held in suspension by a thin film of gas (air cushion). The sphere of such a gyroscope can move within its casing as a result of the force of gravity in addition to the forces generated by the air support and by the stator. Since the ball, while in the casing hollow, can move translationally in any direction and can rotate around any axis that passes through its center of gravity, it must be examined as a mechanical system with six degrees of freedom. It is proposed to model the effect of the suspension on the ball by means of the elastic forces of springs. Using this model, the motion and stability of the ball are investigated in detail. P.V.E.

N64-30366 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INFLUENCE OF CENTRIFUGAL MOMENTS OF INERTIA OF THE INNER GIMBAL OF A CARDAN SUSPENSION ON GYROSCOPE STABILITY
I. N. Sinitsyn *In its* News of the Acad. of Sci. of the USSR. Technol. Section. Mech. and Machine Bldg. 3 Jun. 1964 p 13–18 refs (See N64-30364 22-15) OTS: $1.75

A study was made of the influence of centrifugal moments of inertia of the inner gimbal of a cardan suspension on the stability of gyroscopic motion with vertically and horizontally

positioned spin axes of the outer gimbal. Friction at the axes of suspension was not considered. The investigation was carried out with the aid of Liapunov functions. Author

N64-30367 Honeywell, Seattle, Wash. Ordnance Div.
INTEGRATION OF HONEYWELL MODEL 7182 RADAR ALTIMETER INTO THE FAA AUTOMATIC LANDING SYSTEM Final Engineering Report
8 Apr. 1964 50 p refs Prepared for FAA
(Contract FAA-ARDS-498)
(Rept.-1116-1; AD-600827) OTS: $2.00

CONTENTS:
1. INTRODUCTION 10 p refs
2. RADAR ALTIMETER MUTUAL INTERFERENCE STUDY 37 p refs (See N64-30368 22-15)

N64-30368 Honeywell, Seattle, Wash. Ordnance Div.
RADAR ALTIMETER MUTUAL INTERFERENCE STUDY
In its Integration of Honeywell Model 7182 Radar Altimeter into the FAA Autom. Landing System 8 Apr. 1964 37 p refs (See N64-30367 22-15) OTS: $2.00

Interference effects produced in a pulse altimeter by signal coupling with a nearby FM altimeter were analyzed. It was concluded that the presence of FM interference increases the receiver noise level and thereby degrades the minimum tracking sensitivity of the altimeter. Laboratory tests demonstrated that, at low altitudes, approximately −50 dbm of FMCW power is required to make the receiver break track. The case of mutual interference arising from the signal coupling of two similar pulse altimeters was also analyzed. It was determined that the range-gate-stealing mode of interference is extremely improbable, since system considerations require the PRF's of the two altimeters to agree to better than 1 in 10^7. Because of the low duty cycle and extremely narrow tracking gates of the altimeter, it is unlikely that pulse train interference would perturb the main tracking loop. Extremely high levels of pulse interference would increase the receiver noise level in the same manner as CW interference. Author

N64-30371 National Aeronautical Establishment, Ottawa (Canada)
MAGNETOMETER INSTALLATION IN A NORTH STAR AIRCRAFT
W. M. Strome *In* Natl. Res. Council of Can. Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab., 1 Oct.–31 Dec. 1963 [1963] p 23–30 refs (See N64-30369 22-17)

The Varian Associates Model X-4935 dual-cell rubidium vapor magnetometer is an optically pumped atomic precession device. In order to reduce the magnetic "noise" caused by the aircraft's magnetic fields at the detector, the magnetometer was towed in a "bird" behind the aircraft. The output was a signal whose frequency is approximately proportional to the magnetic field. This signal was heterodyned with the output of a crystal oscillator to give a frequency in the range 500–3000 cps. For analog processing, this signal was converted to a voltage proportional to the frequency. It was also fed to a counter for digital processing. Ground track information was recovered from photographs taken by a downward-looking camera. A coder–programer provided automatic coordination and simultaneous coding of all recorded data. Preliminary trials indicated a considerable noise level under turbulent conditions; under nonturbulent conditions the overall system noise level was approximately 0.1 gamma. R.L.K.

N64-30377 Brookhaven National Lab., Upton, N.Y.
REPORT ON THE LOGICAL DESCRIPTION OF THE SPARK CHAMBER READER
George Schwender Jun. 1964 66 p
(BNL-877(T-353)) OTS: $1.75

A detailed description of the spark-chamber reader is provided. The spark-chamber reader is an automated system for optically scanning 35-mm film, used for recording the events produced by a spark-chamber experiment. The optics provide a spot of light 8 microns in diameter. Two scanning positions are incorporated—a normal and an orthogonal scan. The scan is accomplished by having 16 lenses mounted in a rotating wheel; as each lens passes across a cone of light produced by a mercury arc, a light spot is generated that sweeps across the film. The light passes through the film, and is then monitored by a photomultiplier tube at each window for the determination of the data points. D.E.W.

N64-30437 International Research and Development Co., Ltd. (Gt. Brit.)
INSTRUMENTATION
F. B. Jones, W. Jackson, J. Blunt, R. Brown, and I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 17 p refs (See N64-30427 22-24) OTS: $6.00

Physical measurements on the plasma in the nozzle and channel regions of the MPD loop are required to characterize the plasma state and to compare with theoretical predictions. The parameter of prime importance, insofar as materials problems and plasma properties are concerned, is the gas temperature. The manner in which observed thermocouple temperatures were corrected to yield the static gas temperature is given. During development of the graphite-heater assembly, considerable difficulty occurred because of inaccurate measurement of the power supplied to the heater. Investigations carried out to reduce the inaccuracies are outlined. From experience gained on the preliminary seeded run, a sophisticated power-measurement and leakage system has evolved, and a description of the system is presented. P.V.E.

N64-30519 Martin Co., Baltimore, Md. RIAS Div.
SATELLITE-BORNE INSTRUMENTATION FOR OBSERVING FLUX OF HEAVY PRIMARY COSMIC RADIATION
P. Schwed, M. A. Pomerantz (Franklin Inst.), H. Hanson, and H. Benjamin *In* Franklin Inst., Swarthmore, Pa. Data Reduction and Analysis for Heavy Primary Cosmic Ray Expt. in Explorer VII Satellite 24 Jun. 1964 17 p refs (See N64-30518 22-28) OTS: $3.00 fs; $0.75 mf Repr. from J. Franklin Inst., v. 271, no. 4, Apr. 1961 p 275–291 Supported by NSF

A lightweight (1,150-gram) instrument for measuring the flux of relativistic heavy primary cosmic ray nuclei of $Z \geq 6$ and separating these into three categories according to charge is described. The detector is an ionization chamber 11 cm in diameter and 11 cm long filled with 9 atm of argon. The associated electronics, which consists of a 400-v supply for the ionization chamber, a high input impedance amplifier, and a three-channel pulse height analyzer, is completely transistorized and consumes 54 mw. Author

N64-30559 Sperry Gyroscope Co., Great Neck, N.Y.
RESEARCH IN PREDICTIVE INSTRUMENTATION FOR MANUAL CONTROL Interim Report
Dec. 1963 62 p refs
(Contract Nonr-4197(00))
(HB-9202-0027; AD-602863)

Work in a program to investigate predictive instrumentation techniques for manual control of aircraft is discussed. Predictive instrumentation involves the presentation of information to the vehicle operator regarding the future state of the vehicle as the result of contingent control inputs. Predictive instrumentation puts the projected result of a control input into the context of available time and, in effect, tells the pilot what his future position will be at a given time. The prediction techniques being investigated are of two types. Those based on fixed-stick inputs are termed simple prediction systems, and those based on quickened or director programs to control-stick inputs are called flight-path prediction systems. A descriptive summary of all systems being investigated is presented. P.V.E.

N64-30577 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.

A MEASUREMENT TECHNIQUE FOR VACUUM-DEPOSITED THIN FILMS

Phillip A. Newman and Richard F. Sette Apr. 1964 17 p refs
(TR-2433; AD-603706)

This report presents a laboratory method for the measurement of evaporated thin films in the range 10 to 10,000 A. Utilizing a multiple-beam technique, employing fringes of equal chromatic order and a unique sample holder, films have been measured to a precision of ±15A. Author

N64-30589 Polytechnic Inst. of Brooklyn, N.Y.

A CORRELATION STUDY OF A THERMISTOR THERMOMETER

Michel Boel and Burton Erickson May 1964 34 p refs
(Contract Nonr-839(32) (FBM))
(PIBAL-696; AD-601656)

Using a thermistor in a d.c. bridge configuration, a relationship is developed between the bridge open-circuit output potential and the absolute temperature. This thermistor function accurately predicts temperature magnitudes and changes in temperature over large spans. The function is completely determined by the temperature coefficient of resistance of the thermistor, by a characteristic bridge resistance ratio, and by the absolute temperature. The function has been programed satisfactorily in FORTRAN IV. Author

N64-30611* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A MODERN TRANSISTORIZED INSTRUMENTATION SYSTEM FOR ACOUSTICAL DATA ACQUISITION

Wade D. Dorland, C. C. Thornton, and Denis U. Noiseux (Bolt, Beranek, and Newman, Inc.) Washington, NASA, Sep. 1964 42 p refs
(Contract NAS8-5009)
(NASA-TN-D-2485) OTS: $1.25

To obtain data under a variety of climatic and field conditions with the necessary accuracy, reliability, and in a form readily accepted by existing data-recording facilities, a new instrumentation system was designed, tested, and built. The system consists of a microphone with a preamplifier followed by a step-attenuator and decade amplifier. For transmission of this signal to the recording facility, standard U.S. Army communications field wire is used instead of the conventional coaxial cable. Use of this field wire substantially reduces cost and results in substantially improved reliability and flexibility in field use. Special transformers and floating line amplifiers match the field-wire transmission line to the decade amplifier at the input end and to a signal conditioning unit at the output end of the recording facility. All amplifiers use solid-state devices, and the amplifiers in the field are battery operated. The system is now in use and is performing in a satisfactory manner. The consideration leading to its design and its performance characteristics are described in detail. Circuits, methods of packaging, and the results of tests on the system and its components are given. Author

N64-30619 Harry Diamond Labs., Washington, D.C.

A TEMPERATURE-COMPENSATED, LOW-VOLTAGE REGULATOR

David C. Auth 30 Apr. 1964 22 p refs
(TR-1222; AD-601245) OTS: $0.75

A solid-state, low-voltage regulator accurate to 0.1% with temperature stability has been developed. Employing thermistor compensation, forward-biased diodes, and matched silicon transistors, it represents a significant advance in the state-of-the-art. The circuit discussed yields 1.500 ± 0.001 v at 1 to 15 ma with input voltages of 8 to 12 v over the temperature range −10° to +40° C. Circuit design and derivations for temperature compensation using thermistors and silicon resistors are covered in detail, along with general design criteria for low-voltage regulators. Author

N64-30629 Naval Medical Research Inst., Bethesda, Md.

EFFECTIVE TEMPERATURE SCALE AND ITS MODIFICATIONS

David Minard 12 Mar. 1964 16 p refs
(Rept.-6; AD-603186) OTS: $1.00

Attempts to adapt a familiar instrument or to design a new one for predicting the degree and direction of physiological and subjective responses of the human organism to different levels of air temperature, humidity, air movement, and radiant heat are discussed. Three instruments used singly to obtain indices of heat stress are described: the Wet Kata Thermometer; the Globe Thermometer of Vernon; and the Wet Bulb Thermometer. The Effective Temperature Scale (ET) is discussed and defined. Modifications of the Effective Temperature Scale are outlined, and its deficiencies are evaluated. P.V.E.

N64-30634 Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.

DEVELOPMENT OF EXPERIMENTAL GAS DISCHARGE DISPLAY Quarterly Progress Report No. 3, 24 Nov. 1963–24 Jun. 1964

Jul. 1964 16 p
(Contract NOBsr-89201)
(GR-1457; AD-602865) OTS: $1.00

The purpose of this program is to develop an experimental prototype gas discharge display panel with internal storage capability. The panel will consists of an X–Y matrix of individual glass cells; each can be selected and fired by the application of a short triggering pulse. It was decided to drop all work on the 4 in. × 8 in. display and to concentrate on building two small displays that would simulate two separate conditions. The first was a single line of conventional cells that, when grouped in two's with external resistors, would simulate a piggyback cell with physical isolation between the memory cell and the front display cell. The second was a single line of cells with conventional piggyback construction in which the front display cell sat on top of the memory cell, with no isolation. Two such displays were built, using the Vac Pac construction. They exhibited firing voltages of 250 v, with up to 90 v of hysteresis memory. However, after standing overnight, the firing voltage rose to 500 v. I.v.L.

N64-30641 Atomic Energy of Canada Ltd., Chalk River, Ontario
NEUTRON FLUX MONITORS AND THERMOCOUPLES FOR IN-CORE REACTOR MEASUREMENTS
R. C. Hawkings Jun. 1964 40 p refs Presented at the Symp. on In-Core Instrumentation, Oslo, 15–20 Jun. 1964
(AECL-2033; CRL-85)

The development and present status of in-core neutron flux monitoring devices is reviewed under the following categories: (1) flow type (activation) monitors, exclusive of foils and moving wires; (2) neutron-sensitive ion chambers; (3) solid-state neutron detectors; (4) neutron thermopiles; (5) thermocouple neutron detectors (neutron thermometers); and (6) β-current neutron detectors. Author

N64-30652 Monsanto Research Corp., Dayton, Ohio
METHODS FOR PARTICLE COUNTING IN HYDRAULIC FLUIDS Technical Documentary Report, Sep. 1961–Nov. 1963
Richard A. Anduze and Jay C. Harris Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 51 p
(Contract AF 33(616)-8483)
(ML-TDR-64-72; AD-602984) OTS: $3.00

Four methods of sizing and counting particles in hydraulic fluids and lubricants were studied. Test results on three automatic particle counters—the Cintel Flying Spot Resolver, the Coulter Counter, and the HIAC Particle Counter—were evaluated. Instrument theory and test methods are described. Design and construction of a simple but effective dustless area are given. Two of the automatic counters were found to give counts well within the prescribed precision (±33%). Numerical differences in counts on the same sample are attributable to the measurement of different physical properties by the various methods. Correlations between counts have been made. Precision of the HIAC Counter was established, with standard deviations of 4.1% for the total count, 3.3% in the 6μ to 15μ range, and 11.2% in the 16μ to 25μ range. Author

N64-30694 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
APPLICATION OF PERCEPTRONS TO PHOTO INTERPRETATION Summary Report
H. R. Leland, G. E. Richmond, and M. G. Spooner Aug. 1963 37 p
(Contract Nonr-3161(00))
(VE-1446-G-3; AD-603377) OTS: $2.00

Three phases are summarized of a research program directed toward the development of techniques for automatic recognition of features in photographs. Strong emphasis is placed on the preprocessing of original imagery in order to require only a present state-of-the-art capability in automatic pattern recognition. The validity of the system philosophy being pursued has been generally confirmed, and a number of techniques have been evaluated for accomplishing the various steps in the automatic system. Volume quantities of actual photographic material have been processed within a general-purpose digital computer for detection, isolation, and standardization. Object-recognition results obtained with a simple perceptron are stated to be excellent, in spite of the use of quite badly distorted synthesized object material. D.E.W.

N64-30767 Aerojet-General Nucleonics, San Ramon, Calif.
BIAXIAL CREEP OF MATERIALS IN LITHIUM: DEVELOPMENT OF APPARATUS AND TRIAL RUN WITH TYPE 304L STAINLESS STEEL Spur Power System Topical Report, Period Ending Apr. 1964
J. H. Dannan Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jul. 1964 87 p refs Prepared by Aerojet-Gen. Nucleonics for AiResearch Mfg. Co.
(Contract AF 33(657)-8954)
(SY-5472-R; APL-TDR-64-73; AD-603149)

Creep specimens of the materials to be tested under this program were made by fabricating cylindrical capsules designed to be filled with pressurized lithium. An apparatus to measure the biaxial creep of alloys in contact with lithium up to 2,500° F was constructed and successfully demonstrated. The creep apparatus consists of a high-vacuum-tube furnace with a uniform temperature zone and auxiliary argon pressure systems, and is capable of holding four capsules. Strain is measured by stopping the test periodically and measuring the diameters of the thin sections of the capsule. A trial run in argon was completed with a two-stress, Type 304L stainless-steel capsule filled with lithium. With effective mean stresses of 2,920 and 4,645 psi, the effective strain measured after 1, 2.5, 5, and 11 hours was nearly linear. Author

N64-30794 Georgia Inst. of Tech., Atlanta Engineering Experiment Station
PHOTOGRAPHIC INSTRUMENTATION FOR TRIANGULATION STUDIES OF LUMINOUS CLOUDS IN THE UPPER ATMOSPHERE
M. M. Cooksey, Z. Frentress, and H. D. Edwards Repr. from Appl. Opt., v. 3, no., Mar. 1964 p 399–403 *Its* Repr. No. 172

Instrumentation has been developed for obtaining triangulation photographs of luminous clouds in the upper atmosphere. These clouds are created by the release of chemicals, such as sodium and cesium, from rockets. The instrumentation has been used on approximately 80 rocket firings. Descriptions and operating characteristics are given of the equipment. A modified version of the K-24 aerial camera with 7 in. (17.8 cm) f/2.5 optics was used and mounted on 60-in. (152-cm) searchlight carriages and Mk 51 gun directors. Camera control system, data chamber, fiducial light system, shutter and filter system field installation, and alignment procedures are described. Author

N64-30807 Phillips Petroleum Co., Idaho Falls, Idaho National Reactor Testing Station
DYNAMIC PRESSURE MEASUREMENT DEVICES IN NUCLEAR REACTORS
P. H. Hofhine Aug. 1964 83 p
(Contract AT(10-1)-205)
(IDO-16999) OTS: $1.75

This report discusses the main requisites to be met by a pressure sensor intended for making dynamic pressure measurements in a nuclear reactor conducting transient studies. These requisites pertain to frequency, acceleration, temperature, and radiation responses of the sensor. Also discussed are the techniques developed for determining the frequency and acceleration response of a given sensor. The most common test method utilizes exploding wire techniques to generate pressures of an impulse nature. The other important test technique utilizes chemical explosives to generate longer duration, larger magnitude pressures. Author

N64-30820 Los Alamos Scientific Lab., N. Mex.
DESIGN AND OPERATION OF A NEW AUTOMATIC COMPARATOR FOR MEASUREMENT OF SPECTRA
David W. Steinhaus, Rolf Engleman, Jr., and William L. Briscoe 7 Sep. 1964 81 p refs
(Contract W-7405-ENG-36)
(LA-3100) OTS: $2.00

A list of transmission values at equal intervals along the spectrum plate is made using a precision densitometer with a precision linear comparator. This list is then given to a digital computer along with the formulas relating position to wave number and transmission to intensity. The interval containing each line is found by a technique employing the second differential of the intensity. All the points in this interval are then fitted, by least squares, to a polynomial equation. This equation is then solved for the wave number and intensity of the line. The computer output consists of the wave number, intensity, and shape for each line on the following: (1) a curve, plotting intensity vs position values for the entire spectrum plate; (2) a printed paper listing; and/or (3) a deck of IBM cards for future use. Author

N64-30827 United Electrodynamics, Inc., Pasadena, Calif.
A PEAK LOAD, SELF-RECORDING ON-STRUCTURE STRESS GAGE Final Report
J. R. Stagner and R. Oberchain Kirtland AFB, N. Mex., AF Weapons Lab., Jun. 1964 81 p refs
(Contract DASA-WEB-13.166)
(WL-TDR-64-11; AD-603483) OTS: $4.00

A peak load, self-recording on-structure stress gage was developed, and four developmental prototype units were fabricated. Magnetic tape was used as the recording medium, employing a carrier-erase data-recording technique. The data readout system designed for this project employs a newly developed direct-flux-reading magnetic tapehead. Theoretical and experimental comparisons are made between the flux head and a conventional head. Test results are presented for the above prototype gages. Author

N64-30846* Consultants and Designers, Inc., Arlington, Va.
ASTRONOMICAL STATION FOR OBSERVATIONS IN THE FAR INFRARED REGION OF THE SPECTRUM [ASTRONOMICHESKAYA STANTSIYA DLYA NABLYUDENIY V DALEKOY INFRAKRASNOY OBLASTI SPEKTRA]
S. I. Averkov, V. I. Anikin, V. Ya. Ryadov, and N. I. Furashov 2 Sep. 1964 13 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 41, no. 3, 1964 p 542–544 refs
(Contract NAS5-3760)
(NASA-TT-F-8953; ST-RA-10200) OTS: $1.00 fs, $0.50 mf

The apparatus for astronomical investigations in the far infrared region of the spectrum is described. Their main characteristics and the results of the first observations of solar radiation are given. Author

N64-30866 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
THE SIGNIFICANCE AND MEASUREMENT OF OPTICAL RE-ENTRY OBSERVABLES. VOLUME 2: PHOTOGRAPHIC SPECTROMETRY AND RADIOMETRY
A. Guttman 27 Jul. 1964 36 p refs
(Contract AF 04(694)-499)
(R64SD1023; AD-603016)

Field spectrometry and radiometry on rapidly moving objects customarily utilize imaging instruments. The applicability of such instrumentation in radiometry is discussed with particular emphasis on photographic cine spectrographs, ballistic spectrographs, and ballistic and cine cameras. Appropriate radiant-energy transfer equations for distant point, line, and area sources are given in order to clarify photographic signal interpretation and to define suitable calibrations and reduction procedures. Various types of photographic signal transfer functions are discussed. An example of source parameters derived from actual field measurements is presented to illustrate the degree of consistency and magnitude of errors encountered under actual conditions. Author

N64-30874 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Health Physics and Medical Div.
THE RESPONSE OF PHOTOGRAPHIC FILM DOSIMETERS TO HIGH ENERGY GAMMA RADIATION Research Group Report
P. D. Holt Jan. 1964 39 p refs
(AERE-R-4168)

The calibration of dosimeters (mainly film dosimeters) for gamma energies above 3 MeV is described, with particular reference to the problem of measurement of the 6 MeV gamma radiation from gas-cooled power reactors. In the absence of a national standard for the roentgen at these energies, the dosimeter responses were compared with the readings of condenser ionization chambers that had been calibrated against a standard radium source; factors were then calculated for the conversion of the chamber readings at high energy to absorbed dose in tissue. The response of existing dosimeters (which are designed for energies up to about 3 MeV) varies at high energies according to whether or not secondary electron equilibrium exists; it is shown, however, that equilibrium may usually be assumed to exist in the conditions met in radiological protection Author

N64-30885 Naval Ordnance Lab., Corona, Calif. Dynamics Div.
MATHEMATICAL EXPRESSIONS FOR THE GIMBAL ANGLES OF A ROLL STABLE PLATFORM
Arthur C. Sevy Jul. 1964 32 p
(NOL-TM-75-45; AD-603379) OTS: $2.00

A method is presented for deriving mathematical expressions for the gimbal angles of a free gyro. The method is extended to include redundant gimbals. Equations are derived for a roll stabilized platform with gimbal drifts included, and a cursory error analysis is performed. Author

N64-30889 United Aircraft Corp., East Hartford, Conn. Research Labs.
ULTRASONIC LIGHT SCANNING AND ACTIVE OPTICAL IMAGING SYSTEM
H. G. Aas, R. K. Erf, I. R. Abel, and R. Walker 17 Jul. 1964 59 p refs
(Contract NOw-63-0657-d)
(C930080-12; AD-603084) OTS: $3.00

The development of an ultrasonic light scanning and active optical imaging system is discussed. The report is divided into three sections. The first section briefly reviews the physical principals upon which an ultrasonic optical-beam scanning system operates and considers the various parameters and compromises that must be taken into account when designing an ultrasonic light-beam deflection cell. Representative results obtained with a laboratory demonstration model and a description of the experimental apparatus are included in the second section. In the third section, the principal conclusions of the analytical study of an overall active optical imaging system for operation under actual conditions are reviewed, and some additional promising applications of a laser–ultrasonic scanning system are presented. Work performed during the development studies has demonstrated the following: (1) Light beams can be nonmechanically deflected through angles in excess of 5° by establishing, ultrasonically, a time-varying refractive index gradient in a suitable medium. (2) An active optical imaging system employing two ultrasonic deflection cells, which provide periodic two-dimensional field illumination, is physically realizable. P.V.E.

N64-30890 Atomic Weapons Research Establishment, Aldermaston (Gt. Brit.)
MEASUREMENT OF NEUTRON SPECTRA BY SEMI-AUTOMATIC SCANNING OF RECOIL PROTONS IN PHOTOGRAPHIC EMULSIONS
P. W. Benjamin and G. S. Nicholls Dec. 1963 30 p refs
(AWRE-NR-5/63)

The speed and accuracy of measuring neutron energy spectra by the nuclear emulsion technique have been improved by equipping the microscope to give automatic read out. The recoil track coordinates are punched directly onto computer cards. A scanning rate of 100 to 150 tracks per hour has been achieved. The exposure, development and scanning techniques, the microscope modifications, and the computer program used to analyze the results are described. Author

N64-30991* Hughes Research Labs., Malibu, Calif.
ATTITUDE SENSOR STUDY
Washington, NASA, Apr. 1964 102 p refs
(Contract NAS3-2510)
(NASA-CR-53) OTS: $2.50

To insure operation of a satellite control system using ion propulsion to provide attitude control torques and orbit control impulses, it is imperative that the control system design be compatible with the presently obtainable sensor characteristics. Therefore, a survey of attitude sensors was conducted in order to select a suitable sensor subsystem for the ion engine control system. Sensor attitude systems for both polar orbits and equatorial orbits are presented. Author

N64-31020 Princeton U., N.J. Plasma Physics Lab.
A TECHNIQUE FOR MEASURING PHASE MODULATION OR RAPID PHASE CHANGES OF A MICROWAVE SIGNAL
W. P. Ernst Jun. 1964 28 p refs Presented at the PTGMTT Intern. Symp. Long Island, N.Y., 1964
(Contract AT(30-1)-1238)
(MATT-273)

The system takes advantage of the fact that a phase-modulated carrier signal will produce equivalent frequency modulation, where the change of frequency is proportional to the time rate of change of the phase variation. A microwave carrier frequency fc is shifted in a single-side-band generator to a frequency fc + fm. The upper side band is transmitted through the phase modulating medium and then mixed with the original carrier frequency. The difference frequency fm contains the phase modulation information and, after preamplification, the signal is put through a wide-band limiter–discriminator of center frequency FM. The discriminator output voltage will be directly proportional to the rate of phase change. To compensate for the time rate of change dependency, the discriminator output is followed by an integrating network (Eo ~ 1/f), which will produce an output voltage proportional to the phase change only. Calibration is accomplished by imposing a known amount of phase modulation on the side band modulating signal fm and observing the system output signal. Author

N64-31044 Eastman Kodak Co., Rochester, N.Y. Apparatus and Optical Div.
A STUDY OF IN-FLIGHT FILM PROCESSING Final Technical Report, Jun. 1962–Nov. 1963
F. H. Jackson et al Wright-Patterson AFB, Ohio, AF Avionics Lab., Jan. 1964 158 p
(Contract AF 33(657)-8834)
(AL-TDR-64-6; AD-430281)

A preliminary phase included study of both the fibrous web and bimat processes, as well as a literature investigation. A decision was soon reached to concentrate on the bimat process. Further study of different forms of the process led to the adoption of the 1-minute form of the bimat process which provides access to a positive image in 60 sec. A completely processed negative is available in 5 minutes. The processed films provide positive and negative images of high quality, which meet the required photographic characteristics. Some of the design goals have been exceeded; a close approach has been made to others. With only modest post-processing treatment, the negative is rendered archival and the positive is of commercial quality. Author

N64-31086 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
SOME COMMENTS ON STRAIN GAGE TECHNIQUES FOR DETERMINING MICROSTRAIN
R. D. Carnahan and J. E. White 20 Jun. 1963 10 p refs
(Contract AF 04-695-169)
(SSD-TDR-63-113; TDR-169-3240-31-TN-1; AD-412762)

The use of strain gages in the measurement of strains in the vicinity of 10^{-6} is discussed. Observations of an anomalous anelastic behavior apparently associated with small temperature changes, which accompanies the unload portion of a load–unload microstrain test, are discussed. Author

N64-31096 Stanford Research Inst., Menlo Park, Calif.
PRESSURE TRANSDUCER FOR MEASURING SHOCK WAVE PROFILES ADDITIONAL GAGE DEVELOPMENT Progress Reports, Jun. 1–Jun. 30, 1964
D. D. Keough and R. F. Williams 7 Jul. 1964 6 p refs
(Contracts DA-49-146-XZ-096; DA-49-146-XZ-280)
(PR-34; PR-3; AD-602513) OTS: $1.00

Formulas are derived for calculating the Hugoniot of a mixture of an epoxy resin and another material, whose Hugoniots are known. Calculated shock velocities in various epoxy mixtures are compared with experimental findings. The pressure-resistance hysteresis of Manganin was measured at various peak shock pressures, and the results are presented graphically. D.E.W.

N64-31160 General Mills, Inc., Minneapolis, Minn. Electronics Div.
SELECTION OF APPARATUS FOR A RE-ENTRY SAMPLING EXPERIMENT
A. R. Mc Farland and R. C. Wood Kirtland AFB, N. Mex., Res. and Tech. Div., Oct. 1963 129 p refs *Its* Rept. No. 2407
(Contract AF 29(601)-5371)
(RTD-TDR-63-3043; AD-422097)

A general survey of apparatus used on aircraft, balloons, and rockets to sample particulate matter in the stratosphere has been performed. The various approaches have been evaluated with respect to possible use in a reentry burnup experiment to sample a nonradioactive tracer element. Results indicate that no existing collector can, at this time, be definitely identified as suitable for the experiment. For sampling at altitudes below 70,000 ft, the existing sampler considered most nearly suitable is the aircraft (U-2) hatch filter sampler. With respect to sampling altitudes above 70,000 ft, the AEC balloon-borne, ejector-powered, filter and impactor collectors offer the most promise. No samplers presently in use offer the degree of protection from contamination needed in the reentry experiment. Ways of shielding and cleaning samplers have been investigated. Author

N64-31165 Electro-Optical Systems, Inc., Pasadena, Calif.
DEVELOPMENT OF DEVICES FOR MEASURING OPTICAL RADIATION Technical Documentary Report, 19 Nov. 1962–19 Apr. 1963
H. Bernstein and L. W. Carrier Kirtland AFB, N. Mex., Res. and Tech. Div., Jul. 1963 197 p refs
(Contract AF 29(601)-5691; ARPA Order-313-62; Proj. Defender)
(EOS-3490-Final; RTD-TDR-63-3015; AD-420574)

This report describes the study and analysis of various devices for the measurement of high-intensity optical radiation from lasers. Devices used for both time-resolved and time-integrated measurements were considered. To meet the objectives, the work was divided into three major areas—time-resolved detectors, time-integrated detectors, and associated optics for high-intensity attenuation and beam sampling. Findings of the program indicated that the most promising detector system consists of the vacuum phototube as the time-resolved detector and the calorimeter for the time-integrated detector. In the latter case, it is necessary to use one device for low-energy measurements and a second device for high-energy measurements. As a second choice, the detection pair included a modified image-converter tube and the radiation-pressure pendulum. Author

N64-31237 Kaman Aircraft Corp., Colorado Springs, Colo. Kaman Nuclear
DEVELOPMENT AND FABRICATION OF NON-DESTRUCTIVE SPECIFIC GRAVITY MEASURING EQUIPMENT EMPLOYING RADIATION TECHNIQUE Monthly Progress Report, 1–31 Jul. 1963
[1963] 4 p
(Contract DA-19-029-501-ORD-2631)
(Rept.-58-92-PR-59; AD-421524)

During adjustment for accuracy of the attenuation measuring system, erratic results were traced to the counter. This was removed from the system and completely checked out and realigned. Interaction between calculator and block control circuits was corrected by placing isolating diodes in two circuits to prevent an unwanted feedback from occurring. Final check of scan accuracy was made and corrective action was taken to bring scan accuracy up to that required by inclusion of the length measuring system. A recheck of the length measurement system was initiated. Author

N64-31254 Bureau of Mines, College Park, Md. Applied Physics Lab.
DEVELOPMENT OF A ROCK STRESS MONITORING STATION BASED ON THE FLAT SLOT METHOD OF MEASURING EXISTING ROCK STRESS
Louis A. Panek and John A. Stock Jan. 1964 67 p refs
(BM-RI-6537)

Equipment and procedures have been developed that make possible the installation and operation of a permanent rock stress monitoring station for observing mining-induced stress changes. The station consists of a 12-in.-wide hydraulic pressure cell cemented in a flat slot and four 2- by 8-in. flat hydraulic pressure cells in nearby drill holes. All drilling for the installation can be done with an air leg drill and conventional bits. Once the installation is completed, all required information is obtained by Bourdon pressure gage readings. The apparatus is simple, relatively inexpensive, and reliable under operating conditions in a wet mine. Unlike most methods of rock stress determination, this scheme permits periodic remeasurement of absolute rock pressure over several years, without additional drilling or instrumentation. Similar to other flat slot procedures, stress measurements are obtained without making auxiliary tests to determine elastic properties of the rock or to determine calibration factors for the apparatus. Apparatus, procedures, and performance data are described in detail. Author

N64-31330* National Aeronautics and Space Administration, Washington, D.C.
PHYSICAL AND TECHNICAL PROBLEMS IN THE DEVELOPMENT OF TV CAMERA TUBES [PHYSIKALISCHE UND TECHNISCHE PROBLEME BEI DER ENTWICKLUNG VON FERNSCHAUFNAHMEROHREN]
F. Eckart Sep. 1964 37 p refs Transl. into ENGLISH from Exptl. Tech. Physik (W. Berlin) v. 9, no. 6, 1961 p 261–282 Presented at the Ann. Meeting of The Phys. Soc. in the DDR, Leipzig, 10–13 Apr. 1961
(NASA-TT-F-9103) OTS: $2.00 fs; $0.50 mf

The physical and technical problems of the development of the image orthicon and Vidicon types of TV camera tubes are discussed in detail, especially those connected with development of storage systems and photocathodes or photofilms. The special applications of the infrared Vidicon in research on crystal structure defects in silicon single crystals are pointed out. Author

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-30234 Joint Publications Research Service, Washington, D.C.
VESTNIK OF USSR ACADEMY OF MEDICAL SCIENCES
20 May 1964 168 p Transl. into ENGLISH from Vestnik Akad. Med. Nauk SSSR (Moscow), v 19, no. 2, 1964 p 3–109 (JPRS-24682; OTS-64-31293) OTS: $3.00

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N64-30235 Joint Publications Research Service, Washington, D.C.

THE APPLICATION OF RADIO TELEMETERING TO SPACE MEDICINE

T. T. Akulinichev and R. M. Bayevskiy *In its* Vestnik of USSR Acad. of Med. Sci. 20 May 1964 p 90–97 (See N64-30234 22-16) OTS: $3.00

A general discussion of the need for obtaining biomedical information from spaceships and satellites is presented. Various equipment for obtaining this information is described, and in particular, a brief description is given of the physiological metering system used in the spaceships Vostok III and Vostok IV. Six channels of a spaceship's telemetering system were used to study the following: (1) the electrical activity of the brain in a fronto-occipital lead; (2) the electrical activity of the eyes and oculomotor muscles; (3) the electrical activity of the heart in a bipolar chest lead; (4) respiratory changes in the chest parameter; (5) skin galvanic reaction in the area of the foot; and (6) the heart rate. Also discussed is the possible application of space biotelemetering to ground conditions (e.g., operating rooms). P.V.E.

N64-30236 Joint Publications Research Service, Washington, D.C.

THE APPLICATION OF RADIO TELEMETERING TO STUDIES ON WORK AND SPORT PHYSIOLOGY

V. V. Rozenblat *In its* Vestnik of USSR Acad. of Med. Sci., 20 May 1964 p 98–104 (See N64-30234 22-16) OTS: $3.00

Methods of radio recording a number of indices of the activity of cardiovascular, respiratory, and neuromuscular systems are outlined: Radio telemetering observations, in sport and work physiology, made along three main lines—radiopulsometry, study of respiration, and radio electrocardiography—are discussed. Studies were made of athletes in different specialties and of various occupational groups. Typical changes in the cardiac rhythmn during different exercises and operations have been established. The results of the observations presented confirm the fact that the heart rate is a valuable index that, in an integral manner, reflects the degree of physiological strain brought about by the intensity of physical exertion, nervous–emotional factors, and conditions under which the work is performed. P.V.E.

N64-30237 Joint Publications Research Service, Washington, D.C.

RADIO TELEMETERING STUDY OF THE DIGESTIVE FUNCTIONS

A. S. Belousov, I. I. Malkiman, and A. M. Sorin *In its* Vestnik of USSR Acad. of Med. Sci., 20 May 1964 p 105–114 (See N64-30234 22-16) OTS: $3.00

Radio capsules for recording the pH, the pressure, and the temperature of the gastrointestinal tract are described. Some experiments and their results are discussed. It was found that the use of radio capsules causes no disorders in the digestive functions; that the capsules are well tolerated by sick and by healthy persons; and that they make it possible to conduct long-lasting and continuous observations of the functions of the digestive tract. It is concluded that the method of radiotelemetering investigations of the digestive tract is very promising. P.V.E.

N64-30238 Joint Publications Research Service, Washington, D.C.

DIAGNOSTIC APPLICATION OF ULTRASOUND

M. D. Gurevich and D. I. Tsurupa *In its* Vestnik of USSR Acad. of Med. Sci., 20 May 1964 p 115–119 (See N64-30234 22-16) OTS: $3.00

The present possibilities of echography are based on an analysis of the shape, size, and location of the macroscopic structure of the pathological focus in the surrounding tissues and of the degree to which the ultrasound is reflected. Diagnostic echography apparatus make possible the diagnosis of a number of diseases of different tissues and organs. It is concluded that application of echography to clinical diagnosis shows undoubted promise. P.V.E.

N64-30239 Joint Publications Research Service, Washington, D.C.

THE LATEST IN METHODS OF INVESTIGATION OF THE CARDIOVASCULAR SYSTEM

V. L. Karpman *In its* Vestnik of USSR Acad. of Med. Sci., 20 May 1964 p 120–125 (See N64-30234 22-16) OTS: $3.00

The application of computer technology to the study of the cardiovascular system is discussed. Also discussed are new apparatus used in measuring various parameters and components of the cardiovascular system. Included in the discussion are tachoscillography, dynamocardiography, ultrasonic cardiography, electrokymography, cardiocyclography, phonocardiography, and sphygmographs. P.V.E.

N64-30240 Joint Publications Research Service, Washington, D.C.

NEW METHODS OF NEUROPHYSIOLOGICAL INVESTIGATION

P. G. Kostyuk *In its* Vestnik of USSR Acad. of Med. Sci., 20 May 1964 p 126–155 (See N64-30234 22-16) OTS: $3.00

Methods of analyzing the nervous and muscular activities on the cellular level are discussed, with particular emphasis being placed on methods using intracellular microelectrodes. P.V.E.

N64-30241 Joint Publications Research Service, Washington, D.C.

TRANSLATIONS FROM JOURNAL MEDITSINSKAYA RADIOLOGIYA (MEDICAL RADIOLOGY), VOL. IX, NO. 5, 1964

1 Sep. 1964 60 p refs Transl. into ENGLISH of 6 articles from Med. Radiol. (Moscow), v. 9, no. 5, 1964 (JPRS-26216; TT-64-41475) OTS: $3.00

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3. REACTION OF SPLEEN, LYMPH NODES AND LOOSE CONNECTING TISSUE TO ANTIGENIC STIMULI IN IRRADIATED ANIMALS V. V. Shikhodyrov and N. N. Klemparskaya p 18–28 refs (See N64-30244 22-16)

4. EFFECT OF UNITHIOL UPON COURSE OF ACUTE URANIUM INTOXICATION A. T. Ivannikov p 29–37 refs (See N64-30245 22-16)

5. REMOTE IMMUNOLOGIC CONSEQUENCES OF EFFECT OF IONIZING RADIATION P. N. Kiselev and P. A. Buzini p 38–50 refs (See N64-30246 22-16)

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N64-30242 Joint Publications Research Service, Washington, D.C.

INFLUENCE OF MEXAMINE ON THE COURSE OF GENERAL REACTION OF THE ORGANISM OF PATIENTS SUBJECTED TO RADIATION THERAPY

A. N. Gamaleya, M. D. Donskoy, and A. V. Surikov *In its* Transl. from J. Med. Radiol., V. 9, No. 5, 1964 p 1–8 refs (See N64-30241 22-16) OTS: $3.00

Mexamine in peroral use in doses of 0.05 g 20 to 30 minutes prior to telegamma therapy completely eradicates general reaction for more than half the patients and alleviates its manifestation for another one-third of the patients. Radioprotective properties of mexamine are more manifest in clinical cases where reaction to irradiation is poorly marked (5 from 6 patients), and is less effective in average reaction. Mexamine does not appreciably influence local tissue reactions. In spite of side actions (revealed for one-fifth of the patients), mexamine is a valuable means of combatting general reaction of organisms in radiation therapy. Author

N64-30243 Joint Publications Research Service, Washington, D.C.

CHANGES IN FRACTIONAL COMPOSITION AND COLLOIDAL STABILITY OF SERUM PROTEINS IN RABBIT BLOOD IN RADIATION SICKNESS

Yu. M. Madiyevskiy *In its* Transl. from J. Med. Radiol., V. 9, No. 5, 1964 p 9–17 refs (See N64-30241 22-16) OTS: $3.00

Irradiation with 200 r is accompanied by a reduction in β-globulins (2nd to 20th days) and an increase in γ-globulins (7th to 20th day); the content of albumin and α-globulins remains constant. The thermal coagulation time of the blood serum lengthens (up to 25%) from the 1st through the 4th and on the 10th day after irradiation. Irradiation with 800 r is accompanied by hypoalbuminemia (1st to 30th days), hyper-α- and β-globulia (1st to 10th days) and hyper-gamma-globulia (starting from 30th day). The lengthening of the thermal coagulation time (up to 58%) is observed from the 1st through the 30th day after irradiation. Author

N64-30244 Joint Publications Research Service, Washington, D.C.

REACTION OF SPLEEN, LYMPH NODES AND LOOSE CONNECTING TISSUE TO ANTIGENIC STIMULI IN IRRADIATED ANIMALS

V. V. Shikhodyrov and N. N. Klemparskaya *In its* Transl. from J. Med. Radiol., V. 9, No. 5, 1964 p 18–28 refs (See N64-30241 22-11) OTS: $3.00

When heated vaccine from paratyphoid Breslau bacillus is introduced, there is a change of spleen, lymph nodes, and loose connecting tissue. After 5 to 10 days, there is an increase of divisible cells in spleen and lymph nodes. In loose connecting tissue, there is an increased quantity of young fibroblasts and macrophages. Monotypic changes occur in spleen and lymph nodes of white mice irradiated in doses of 500 r; dystrophic changes occur in the loose connecting tissue. There are fewer morphologic changes in animals irradiated 20 days after immunization. A.W.

N64-30245 Joint Publications Research Service, Washington, D.C.

EFFECT OF UNITHIOL UPON COURSE OF ACUTE URANIUM INTOXICATION

A. T. Ivannikov *In its* Transl. from J. Med. Radiol., V. 9, No. 5, 1964 p 29–37 refs (See N64-30241 22-16) OTS: $3.00

Unithiol is not effective in accelerating the excretion of uranium from an organism. Its injection increases the accumulation of uranium in skeleton and retards its excretion with urine. Application of unithiol in a case of uranyl nitrate poisoning causes more acute uranium intoxication and is accompanied by more diffuse lesion of kidney ducts. However, earlier application of unithiol during poisoning by uranyl nitrate in small doses (5 mg/kg) lowers mortality of white rats by 30%, as compared to control. This is apparently the result of the normalizing effect of unithiol on metabolistic processes. Author

N64-30246 Joint Publications Research Service, Washington, D.C.

REMOTE IMMUNOLOGIC CONSEQUENCES OF EFFECT OF IONIZING RADIATION

P. N. Kiselev and P. A. Buzini *In its* Transl. from J. Med. Radiol., V. 9, No. 5, 1964 p 38–50 refs (See N64-30241 22-16) OTS: $3.00

The more sensitive an organism is to radiation and the greater the damage it sustains, the longer the organism retains the negative immunologic consequences of the radiation sickness it suffered. Experiments also indicated faster restoration of immunity for white mice as compared to guinea pigs, which are more sensitive to radiation. Disturbance in immunity cannot be classed, in principle, as irreparable damage. However, natural immunity is recovered very slowly. A.W.

N64-30247 Joint Publications Research Service, Washington, D.C.

RADIOSENSITIVITY OF MICE AFTER SPLENECTOMY AND APPLICATION OF HOMOGENATE OF SPLEEN TISSUE IN CHRONIC RADIATION SICKNESS

K. L. Kovalevskiy *In its* Transl. from J. Med. Radiol., V. 9, No. 5 1964 p 51–57 refs (See N64-30241 22-16) OTS: $3.00

It was shown that after a splenectomy mice develop leucocytosis. The number of leucocytes is first reduced and then restored to the initial figures for animals in the experimental group (removed spleen) at a later stage than for the control. Autopsies disclosed a hemorrhagic syndrome in mice subjected to splenectomy, whereas for control mice (with spleen) hyperemia and swollen internal organs were observed. There is more serious radiation sickness and higher mortality for mice

subjected to splenectomy than for animals with preserved spleens, irradiated by the same doses of X-rays. In splenectomized mice, after injections of homogenate of homologic spleen tissue during the first few hours after X-ray, irradiation mortality is reduced. Homogenate of spleen prevents the occurrence of multiple hemorrhages in internal organs when injected into organisms of irradiated mice. Author

N64-30343* Harvard School of Public Health, Boston, Mass.
LIVING IN SPACE
Ross A. Mc Farland *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 173–175 (See N64-30326 22-01) GPO: $1.50

Some of the implications of the space program for medicine and the biological sciences are examined. Included is work in such areas as the effects of the environment on health and performance, the description and measurement of "normal health," the operation of basic physiological mechanisms under stress, and the refinement of instrumentation for observing, recording, and analyzing physiological data. R.L.K.

N64-30344* National Aeronautics and Space Administration. Manned Spacecraft Center, Langley Station, Va.
THE MEDICAL SUPPORT OF MANNED SPACE FLIGHT
Charles A. Berry *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 177–186 (See N64-30326 22-01) GPO: $1.50

The program is described in detail in the areas of crew selection and training, medical maintenance and preflight preparation, medical monitoring, and the evaluation of physiological responses to space flight. R.L.K.

N64-30345* Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
SPACE-CABIN ATMOSPHERES
Emanuel M. Roth *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space. 1964 p 187–193 (See N64-30326 22-01) GPO: $1.50

In selecting a space-cabin atmosphere, a complex interaction between human physiology, the gaseous environment, the machine, and the mission must be considered. Outlined are the major reasons for uncertainty and the problems of optimizing the man–machine system in this respect. The physical variables include total pressure, oxygen pressure, carbon dioxide pressure, inert-gas pressure, water-vapor pressure, gaseous trace contaminants, thermal properties of gas, circulation and temperature of gas, leakage rate of gas, duration of exposure, and gravitation level. The physiological, physical, and pathological variables on which these environmental variables may act include alertness and performance, decompression syndromes, radiation sensitivity, fire and blast hazards, bacterial flora changes and infections, water physiology, respiratory physiology, oxygen-toxicity syndrome, and thermal control problems. Project Mercury successfully used 100% oxygen at 5 psi for simplicity of control engineering and minimization of weight, but Cooper's 34-hour flight was apparently just under the wire for oxygen toxicity. R.L.K.

N64-30391 Joint Publications Research Service, Washington, D.C.
RECENT DEVELOPMENTS IN MEDICAL INSTRUMENTS
27 Jul. 1964 52 p refs Transl. into ENGLISH of a booklet "Pribory i Apparatura Olya Biologicheskikh Issledovaniy i Meditsinskoy Diagnostiki" Moscow, State Sci. Res. Inst. of Sci. and Tech. Inform., 1962 p 1–28
(JPRS-25587; TT-64-31859) OTS: $2.00

CONTENTS:

1. THE CLINICAL ELECTRO-CARDIO-STIMULATOR EKSK-1 A. L. Baranovskiy, G. Z. Ganelin, and L. T. Danilevich p 1–12 (See N64-30392 22-16)
2. AN ELECTRONIC INSTRUMENT FOR DETERMINING THE SPEED OF PULSE WAVE PROPAGATION A. I. Gefter, S. S. Belousov, T. M. Tarantovich, and V. A. Mel'nikova p 13–17 (See N64-30393 22-16)
3. INSTRUMENT FOR STUDYING THE VOCAL CORDS N. E. Rabinovich p 18–25 (See N64-30394 22-16)
4. A METHOD OF MEASURING DIFFUSION AND CAPILLARY-OSMOTIC PROCESSES p 26–30 refs (See N64-30395 22-16)
5. AN APPARATUS FOR SYNCHRONIZED TREATMENT OF BIOLOGICAL OBJECTS WITH MODULATED MICROWAVES "SINKHROIMPUL'S" A. R. Livenson and V. A. Gavrilin p 31–46 refs (See N64-30396 22-16)

N64-30392 Joint Publications Research Service, Washington, D.C.
THE CLINICAL ELECTRO-CARDIO-STIMULATOR EKSK-1
A. L. Baranovskiy, G. Z. Ganelin, and L. T. Danilevich *In its* Recent Develop. in Med. Instr. 27 Jul. 1964 p 1–12 (See N64-30391 22-16) OTS: $2.00

The operation and circuitry of a clinical electrocardiostimulator is discussed. The stimulator is a low-frequency generator of current pulses with three variable parameters: recurrence frequency, duration, and amplitude. The pulse recurrence frequency is limited between 30 and 200 pulses per minute, and can be changed in a continuous manner. The pulse duration has limits of 1 to 10 milliseconds, and the duration control is discrete through 1 millisecond. The amplitude of the pulse current is within the limits of 0 to 150 milliamperes, and has three subbands—0 to 15 ma, 0 to 75 ma, and 0 to 150 ma. The amplitude control within the limits of a subband is discrete with 11 steps. P.V.E.

N64-30393 Joint Publications Research Service, Washington, D.C.
AN ELECTRONIC INSTRUMENT FOR DETERMINING THE SPEED OF PULSE WAVE PROPAGATION
A. I. Gefter, S. S. Belousov, T. M. Tarantovich, and V. A. Mel'nikova *In its* Recent Develop. in Med. Instr. 27 Jul. 1964 p 13–17 (See N64-30391 22-16) OTS: $2.00

An instrument for measuring the propagation speed of pulse waves in arteries is described. The instrument is an electric mechanism consisting of two amplifying channels, gating circuits that control polarized relays, a triggering mechanism, an electronic timer, and a power unit. The operating principle of the instrument consists of separately amplified signals taken from transducers fixed at two various points of the arterial system that control the electronic timer, permitting the determination of the time difference between two pulses. P.V.E.

N64-30394 Joint Publications Research Service, Washington, D.C.
INSTRUMENT FOR STUDYING THE VOCAL CORDS
N. E. Rabinovich *In its* Recent Develop. in Med. Instr. 27 Jul. 1964 p 18–25 (See N64-30391 22-16) OTS: $2.00

An electronic laryngostroboscope, developed to observe and study the vocal cords, is described. A system of feedback is utilized to provide synchronization between the light flashes and the oscillations of the vocal cords. A laryngophone, fastened on the neck of the patient at the clavicular notch, where the sounds caused by the working of the vocal cords are easily heard, picks up the oscillations of the vocal cords and delivers

electrical signals from the whole spectrum of sound frequencies to the input of the control unit. Sinusoidal oscillations picked out of the spectrum and corresponding to the basic frequency of the oscillations of the cords are transformed into impulses that are relayed to the illumination unit consisting of an ignition system and a gas-discharge tube. The light flashes are directed, with the help of frontal and laryngeal mirrors, into the larynx of the patient. P.V.E.

N64-30395 Joint Publications Research Service, Washington, D.C.
A METHOD OF MEASURING DIFFUSION AND CAPILLARY-OSMOTIC PROCESSES
B. V. Deryagin, M. M. Milekhina, and V. I. Andreyev *In its* Recent Develop. in Med. Instr. 27 Jul. 1964 p 26–30 refs (See N64-30391 22-16) OTS: $2.00

A method of determining the kinetics of diffusion and capillary-osmotic processes, using radioactive isotopes, is presented. Also presented are the results of some measurements obtained using the method. P.V.E.

N64-30396 Joint Publications Research Service, Washington, D.C.
AN APPARATUS FOR SYNCHRONIZED TREATMENT OF BIOLOGICAL OBJECTS WITH MODULATED MICROWAVES "SINKHROIMPUL'S"
A. R. Livenson and V. A. Gavrilin *In its* Recent Develop. in Med. Instr. 27 Jul. 1964 p 31–46 refs (See N64-30391 22-16) OTS: $2.00

A system developed for synchronized treatment of a biological object by pulse (modulated) microwaves is described. The system of blood circulation, particularly the pulse wave or the heart's electrical activity, is used as the rhythmic function. In the apparatus used, a magnetron generator operating on a frequency of 2,375 mc/sec acts, with the help of a directed radiator, on the living organism. A transducer picks up the pulse wave—the wave of an electrocardiogram—and an electronic shaping mechanism produces signals controlling the modulator. P.V.E.

N64-30465 California U., Los Angeles Brain Research Inst.
STUDIES OF BRAIN FUNCTION AND BEHAVIOR Final Report, May 1, 1961–Apr. 30, 1963
J. D. French, W. R. Adey, and H. W. Magoun 25 May 1964 10 p refs
(Grant AF-AFOSR-61-81)
(AFOSR-64-1195; AD-442844)

The studies of brain function and behavior are summarized under the following headings: (1) the EEG correlation with behavioral processes; (2) studies of basic sleep mechanisms; (3) the EEG and behavioral studies of monkeys raised in darkness; (4) studies of urinary steroid excretion in monkeys exposed to simulated orbital flight; (5) exposure of monkeys to acceleration and vibration stresses; (6) development of a chimpanzee stereotaxic brain atlas; (7) development of an EEG recording system for use in aerospace flight; and (8) computer techniques in analysis of EEG data. P.V.E.

N64-30493 Naval School of Aviation Medicine, Pensacola, Fla. Naval Aviation Medical Center
SIGNIFICANT PHYSIOLOGICAL PARAMETERS OF THE BALLISTOCARDIOGRAM AS ANALYZED BY A MATHEMATICAL MODEL
Robert L. Morse 8 Jan. 1964 22 p refs
(Rept.-11; AD-439502)

Investigation by means of a mathematical model and digital computer demonstrates that specific abnormalities of the human acceleration ballistocardiogram may be due to corresponding variations in arterial pulse wave shape and arterial elasticity. Author

N64-30498 School of Aerospace Medicine, Brooks AFB, Tex.
HEMATOLOGIC CHANGES FOLLOWING SIMPLE EXODONTIA
Ira L. Shannon, Edward E. Davis, and William A. Gibson Nov. 1963 11 p refs
(SAM-TR-63-82; AD-439666) OTS: $1.10

Hematologic studies were carried out on 90 systemically healthy, young adult males, some of whom underwent a simple exodontic experience. In one experiment, blood samples were collected before and at 2- and 4-day intervals after tooth removal. In another, blood was drawn prior to and at 4 hours after exodontia. In the 4-hour study, significant changes following extraction were noted for white blood cells, neutrophils, lymphocytes, hematocrit, and corrected sedimentation rate. Only the latter factor was found to change significantly in the 4-day study. These results are related to previously established adrenocortical hyperactivity in patients undergoing comparable dental procedures. Author

N64-30504* Little (Arthur D.) Inc., Cambridge, Mass.
ON CREDIBLE CATASTROPHIC ENVENTUALITIES IN SELECTED AREAS OF GOVERNMENT-SPONSORED ACTIVITIES
Sep. 1963 127 p refs Prepared for Columbia U.
(Contract NASr-181)
(NASA-CR-58145) OTS: $4.00 fs; $1.00 mf

Using the criterion of $20 million damage as the threshold of catastrophic devastation, eventualities are selected that are credible since they result from a combination of incidents, each of which has occurred in the past on separate occasions. One hazard considered is the transportation of missile propellants and their incompatibility with industrial compounds that are shipped in much larger quantities. Shipping regulations are directed to the properties of the chemicals per se, with reduced attention given to incompatibility with other chemicals. A second credible hazard of lower probability, because of the limited number of firings, is from the failure of a large chemical rocket during launch. Hazards peculiar to military aircraft during an increased alert status, or under automatic direction from the ground, are evaluated. Nuclear-propulsion danger is difficult to specify because designs for candidate motors are still under investigation, but the most serious credible accident does not appear to be in the catastrophic range. The most hazardous of weather-control attempts—hurricane control—might produce calamitous damage during experimental work. R.L.K.

N64-30536* Gaustad Mental Hospital, Oslo (Norway) EEG Lab.
COLLECTION OF BIOLOGICAL INFORMATION DURING PROLONGED FLIGHT MISSIONS WITH "YES AND NO" DATA REDUCTION ANALYSIS
C. W. Sem-Jacobsen, E. Kaiser, and I. E. Sem-Jacobsen Repr. from Aerospace Med., v. 35, Sep. 1964 p 880–883 refs
(Contract NAS2-1235)

Biomedical and technical data collected during simulated and actual flight missions may be recorded on multichannel magnetic tape or paper. This can be accomplished by a "yes"

and "no" system. The prime data are fed to detector bridges, which give positive and negative output tension according to the input signals and criteria set. The information is coded on punch tape and is grouped in frames that contain 100 characters, which are punched at the rate of 50 characters per second. A master code consists of several "yes" and "no" answers and is set according to experience and present criteria. Data on the frames are reduced drastically, but permit immediate vital information through processing by a computer. I.v.L.

N64-30538 Hammersmith Hospital, London (Gt. Brit.)
FACTORS MODIFYING THE ACTION OF NEUROMUSCULAR BLOCKING AGENTS Third Quarterly Technical Status Report, 1 Oct.–31 Dec. 1963
J. P. Payne [1963] 4 p
(Contract DA-91-591-EUC-2881)
(AD-439674)

Experiments with compound 1420 were performed on rat-diaphragm preparation to demonstrate any action of the drug at the motor end plate. It was found that small doses of the compound (3 to 4 mg) would produce a partial block when the muscle was stimulated indirectly, but that direct stimulation was not affected. When 1420 was given after tubocurarine, gallamine, and decamethonium, its blocking effect was found to be more enhanced with decamethonium than with the competitive blocking agents. Compound G.34075 was tested on rat-diaphragm preparation to establish its effect on the muscle twitch elicited by direct and indirect stimulation. The twitch response was blocked with both types of stimulation, but the onset of 100% block was slower when the muscle was stimulated directly. Diallyl-nor-toxiferin produced neuromuscular block at a dose level similar to that of tubocurarine; direct muscle stimulation was unaffected. The effect of pH on the action of the drug was studied, and it was observed that its action was enhanced as the pH was raised to a maximum of 9. P.V.E.

N64-30569 Mississippi State U., State Coll.
PHYSICAL, CHEMICAL AND MICROBIOLOGICAL EVALUATION OF ELECTROCHEMICAL DEGRADATION OF HUMAN WASTES Informal Progress Report No. 7, 1 Jan.–31 Mar. 1964
[1964] 22 p refs
(Contract AF 41(609)-1633)
(AD-605724)

Studies on the growth rate of *Chlorella 71105* in various types of EDO were conducted to determine whether a deficiency or toxicity exists in the EDO. It was determined that a superior rate of growth was obtained when the EDO was filtered. The optimum period of electrolysis when the DO was diluted prior to electrolysis was 72 hours. Macroelements used to make Knop's medium did not increase the growth of *Chlorella 71105* when added to the EDO independently. A slight increase in growth rate was observed when the microelements were added to the EDO as a group. The dilution of the EDO at the rate of 1:20 and 1:100 did not enhance the growth of the test alga. Electrolysis of the undiluted DO and subsequent dilution to 1:5 produced the greatest increase in growth of *Chlorella 71105* recorded to date. Nitrite nitrogen, phosphates, and sulfates were determined. Author

N64-30570 London U. (Gt. Brit.) Queen Mary Coll.
CARBOXYLATION MECHANISMS IN PHOTOSYNTHESIS Annual Summary Report, 1 Oct. 1962–30 Sep. 1963
Margaret Birmingham and C. P. Whittingham Oct. 1963 18 p refs
(Contract AF-EOAR-62-24)
(ASR-3; AD-429263)

The following experiments are discussed: (1) feeding experiments with glucose-U-C^{14}—the effect of CO_2 concentration on the photometabolism of glucose-U-C^{14} in *Chlorella* (in the presence of INH); (2) feeding experiments with specifically labeled glucose—investigations using glucose specifically labeled in the one-, two-, or six-carbon atoms; (3) feeding specifically labeled glucose at CO_2 free air; (4) effect of oxygen on photometabolism of glucose; (5) degradation of glycollate produced during the photometabolism of radioactive glucose; and (6) feeding experiments with serine-3-C^{14}. P.V.E.

N64-30602 Argonne National Lab., Ill.
THE DETERMINATION OF INORGANICALLY BOUND IODINE-131 IN URINE
William D. Fairman Jun. 1964 25 p refs
(Contract W-31-109-ENG-38)
(ANL-6887) OTS: $0.50

Inorganically bound iodine-131 is separated from other urinary constituents by ion exchange on a silver chloride column. After removal as iodic acid from the column by acidified chlorine water, the iodine is subjected to two oxidation–reduction solvent-extraction cycles and finally precipitated as silver iodide. The mounted precipitate is beta and/or gamma counted. Chemical and radiochemical yields are 87.2 ±1.5%. Total time for the procedure (exclusive of counting time) is approximately 2 hr for a single sample. Tracer interference experiments show that silver, chloride, bromide, and mercury exchange onto the silver chloride, but these elements are removed in the elution and extraction steps. The other elements studied—cadmium, cerium, antimony, ruthenium, tellurium, molybdenum, and technetium—do not exchange onto the silver chloride. Author

N64-30613 Joint Publications Research Service, Washington, D.C.
STUDIES ON IONIZING RADIATION
V. N. Strel'tsova and Y. I. Moskalev 24 Sep. 1964 106 p Transl. into ENGLISH of parts of the book "Blastomogennoye Deystviye Ioniziruyushchey Radiatsii" Moscow, Meditsina Publishing House, 1964
(JPRS-26532; TT-64-41790) OTS: $4.00

Portions of chapters from the book "Blastogenic Effect of Ionizing Radiation" are presented. These are the chapters: (1) "Development of Leukoses under the Influence of Ionizing Radiation;"(2) "General Mechanisms of Tumorgenesis Induced by Ionizing Radiation;" and (3) "Some Questions Relating to the Pathogenesis of Radiation-Induced Tumors." Highlights of Chapter (1) are as follows. All leukoses are caused by different kinds of radiation and radioactive isotopes, each possessing a different type of distribution. Total irradiation possesses greater leukoses activity than local irradiation. Uniformly distributed isotopes, possessing mixed low-power beta–gamma radiation (Ce^{135}, Nb^{95}) induce the appearance of leukoses relatively more frequently than do isotopes that are selectively deposited in bone tissue and the liver. Chapter (2) shows that the capacity of ionizing radiation, including radioactive isotopes, to induce tumors depends not only upon the localization of the irradiation but also upon the "reactivity" of the irradiated tissue, which is determined by the presence and intensity of mitotic cycles, regeneration capacity, radiosensitivity, etc. Chapter (3) states that neoplasmas of radiation etiology may be considered as somatic mutations. The mechanisms involved in the appearances of these mutations may vary. They may be caused by chromosome injury, by injury to the enzyme systems of the oxidative cycle, etc. I.v.L.

N64-30623 Brookhaven National Lab., Upton, N.Y.
THE IMPACT OF ISOTOPIC TRAGERS ON PHYSIOLOGICAL CONCEPTS
James S. Robertson 12 Feb. 1964 17 p refs *Its* Lecture Series No. 33
(BNL-857(T-341)) OTS: $0.50

This lecture gives a historical background, in order to describe the state of thinking at the time of the discovery of radioisotopes, and discusses the qualitative aspects of some basic discoveries made possible by and through the use of radioisotopes. In addition, an analytical interpretation of the kinetic behavior of tracers—the quantitative aspects of the tracer theory—is presented. I.v.L.

N64-30696 Naval Medical Research Inst., Bethesda, Md.
PRACTICAL SOLUTIONS TO PROBLEMS OF THIRST IN CLOSED OR OPEN SPACES
Julius Sendroy, Jr. 27 Jan. 1964 12 p refs Presented in Part at the 1st Intern. Symp. on Thirst in the Regulation of Body Water, Florida State U., Tallahassee, May 1963
(Rept.-3; AD-603261) OTS: $1.00

A review is given of work done on the problem of obtaining an adequate supply of water for drinking pruposes, under conditions of unusual stress such as may be experienced by survivors of shipwreck at sea, or by the passengers of a space vehicle. The experimental and practical development of a chemical briquet that converts sea water to a potable fluid is described, for the use of castaways at sea. Several chemical approaches, and an ultimate physical one involving the principle of freeze-drying, are used to produce potable water from urine in a repetitious sequence of physiological and physicochemical cycling of this vital fluid. Author

N64-30703 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EXAMINATIONS OF THE EFFECT OF LOW FREQUENCY MECHANICAL VIBRATIONS ON CHANGES IN THE BLOOD OF WHITE RATS
Ewa Otto-Buczkowska and Edmund Stoklosa 28 Jul. 1964 11 p refs Transl. into ENGLISH from Acta Physiol. Polonica (Poland), v. 14, no. 5, 1963 p 533–539
(FTD-TT-64-242/1; AD-446787)

Experiments were performed with 30 white rats of the Wistar breed. In the course of 2 hours the animals were submitted to the action of vibrations of frequency 5 Hz and amplitude 20 mm in a specially constructed apparatus. Examinations of the peripheral blood and bone marrow were carried out before and after the vibrations. In the animals submitted to the action of vibrations there were observed a pronounced decrease in the number of erythrocytes and an increase in the number of leucocytes with a predominance of neutrophilic granulocytes. In the bone marrow, stimulation of the myeloblastic system was noted. Author

N64-30712 School of Aerospace Medicine, Brooks AFB, Tex.
LECTURES IN AEROSPACE MEDICINE, 3–7 FEBRUARY 1964
[1964] 325 p refs
(AD-445253)

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N64-30713 School of Aerospace Medicine, Brooks AFB, Tex.
KEYNOTE ADDRESS: A YEAR OF PROGRESS
Theodore C. Bedwell, Jr. *In its* Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 4–12 (See N64-30712 22-16)

In the conquest of space, the study of human responses to novel environments is invaluable. The Air Force and NASA have achieved notable success in their increasing cooperation in the fields of aerospace medicine and bioastronautics. The highlights of one year's progress are reviewed. A.W.

N64-30714* National Aeronautics and Space Administration, Washington, D.C.
NASA PROGRESS IN LIFE SCIENCES

Hugh L. Dryden *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb., 1964 [1964] p 13–25 (See N64-30712 22-16)

The space-medicine program began with the flight of Alan B. Shepard, Jr., in the first of the Project Mercury series. Bioinstrumentation for this flight and for the second manned suborbital flight measured respiration only, but with actual orbital flight, more sophisticated measurements (such as those of blood pressure) came into being. Weightlessness as a hazard in space was also studied. Future flights, such as Gemini and Apollo, will test man's responses in space for periods of weeks. Basic research in the life sciences is divided into four headings—Behavioral Biology, Environmental Biology, Exobiology, and Physical Biology—each of which is discussed. A.W.

N64-30715 Naval School of Aviation Medicine, Pensacola, Fla.
NAVAL MEDICAL SUPPORT OF THE NATIONAL SPACE PROGRAMS
Langdon C. Newman *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 26–35 (See N64-30712 22-16)

Some of the aspects discussed of Naval medical support of the space programs are the pioneering pre-Mercury flights of rhesus and squirrel monkeys; the centrifuge development; the Navy Mark IV pressure suits; recovery at sea; and medical research in weightlessness, with particular emphasis on the vestibular organs. A.W.

N64-30716 Air Force Dept., Washington, D.C.
AIR FORCE MEDICAL SUPPORT OF THE NATIONAL SPACE PROGRAMS
Richard L. Bohannon *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 36–41 (See N64-30712 22-16)

The Air Force contributed the flight surgeon as a vital member of the support team for the man in space. Additionally, the Air Force conducts extensive research in solar flares, one of the greatest hazards to manned space flight. It is also studying the "level of arousal" in man during performances of his job in space. Through its simulators, the Air Force duplicates environmental conditions of space and tests human responses thereto. It has also assisted in screening and selecting astronauts. Perhaps its most important contribution will be the manned orbiting laboratory, which is now under development. A.W.

N64-30717 School of Aerospace Medicine, Brooks AFB, Tex.
NEW INFORMATION ON SOLAR FLARES AND SPACE RADIATION
Edwin R. Ballinger *In its* Lectures on Aerospace Med., 3–7 Feb. 1964 [1964] p 42–49 (See N64-30712 22-16)

There are three potential radiation hazards in space—galactic cosmic radiation, the Van Allen belts, and solar flares. Of these three, the most dangerous are the solar flares. Suggested protection against these flares includes prediction, shielding, maneuverability, onboard monitoring devices, and biological protection. These are explained and discussed. A.W.

N64-30719* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ESTABLISHMENT OF ENVIRONMENTAL RISKS
John M. Eggleston *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 73–92 (See N64-30712 22-16)

Discussion is given of some of the environmental factors that will affect the Apollo mission. The most important of these are solar flares, meteoroids, lunar-surface ejecta, the lunar surface itself, photometric characteristics of the moon, and lunar temperatures. A.W.

N64-30725* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
DEVELOPMENT OF THE APOLLO PORTABLE LIFE SUPPORT SYSTEM
William C. Kincaide *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 182–192 refs (See N64-30712 22-16)

The Apollo portable life-support system provides a habitable environment for the extravehicular explorer while he is exposed to the extreme environments of free space and the lunar surface. Basically, the assembly consists of an anthropomorphic pressure garment including helmet, gloves, boots, a back-mounted portable life-support system, which also contains the communication–telemetry package, an emergency oxygen system, and a thermal protective garment that will isolate the entire assembly from the external environmental extremes anticipated. The pressure garment, helmet, gloves, and boots also serve as backup to the cabin pressurization system. Author

N64-30727 School of Aerospace Medicine, Brooks AFB, Tex.
HAZARDS IN OXYGEN ENVIRONMENT
Hans-Georg Clamann *In its* Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 208–224 refs (See N64-30712 22-16)

The question is discussed as to whether the prolonged inhalation of oxygen of high percentage at normal or near-normal partial pressure, but at low total pressure, has adverse effects upon man. Experiments carried out in this connection show no adverse effects. A second experiment carried out at ambient pressure, high oxygen partial pressure, and high percentage (90%) resulted in definite signs of oxygen poisoning. A clear answer has not been found to the problem of exposing an astronaut to a given oxygen pressure for long periods of time. A.W.

N64-30729* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACECRAFT ENVIRONMENTAL SYSTEMS DEVELOPMENT PROGRAMS
Frank H. Samonski, Jr. *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 234–238 (See N64-30712 22-16)

A comparison is made between the test philosophy and the development test programs conducted for the Project Mercury environmental control system and those planned for the Projects Gemini and Apollo environmental control systems. Author

N64-30742 Joint Publications Research Service, Washington, D.C.
METABOLISM DURING RADIATION INJURIES
N. F. Lipkan 22 Sep. 1964 82 p Transl. into ENGLISH of Pt. II from the book "Elementy Radiatsionnoy Biologii i Biokhimii" Kiev, 1963 p 45–136
(JPRS-26500; TT-64-41758) OTS: $3.00

The following are discussed: (1) Radiochemical Processes in the Tissues; (2) Protein and Nucleic Acid Metabolism; (3) Carbohydrate Metabolism; (4) Oxidation–Reduction Processes and Energy Metabolism; (5) Fat Metabolism; (6) Mineral and

Water Metabolism; (7) Changes in the Biological Activity of Enzymes, Hormones, and Vitamins; (8) Radiation Injuries of Individual Systems, Organs, and Tissues; and (9) Normalization of Metabolism During Radiation Injuries. Author

N64-30754 Cornell U., New York, N.Y.
THE PREVENTION OF INFECTION IN ACCIDENTAL WOUNDS
Donald Kaye and Edward W. Hook [1963] 115 p refs
(Contract PH-86-62-170)

The literature concerning infection in wounds and in burns is reviewed, and specific recommendations are made for the prevention of pyogenic and clostridial infections. The emphasis is on management in mass-casualty situations resulting from acts of war. Sections are included on the pathogenesis and manisfestations of infection, on radiation and infection, and on the use of hyperbaric oxygen. R.L.K.

N64-30777 Joint Publications Research Service, Washington, D.C.
SOME CURRENT PROBLEMS IN CELL REGULATION
Bela Faludi, Tamas Frey, Endre Biro et al 25 Sep. 1964 138 p refs Transl. into ENGLISH of a series of lectures from Magy. Tudo Akad. Biol. Oszt. Kozlemen. (Budapest), v. vii, no. 1–2, 1964
(JPRS-26558; TT-64-41816) OTS: $4.00

CONTENTS:

1. SOME CURRENT PROBLEMS IN CELL REGULATION B. Faludi, T. Frey, and E. Biro p 1–27 refs
2. REGULATION OF MATERIAL UPTAKE IN PLANT CELLS Z. Boszormenyi p 28–60 refs
3. BIOLOGICAL TRANSPORT PHENOMENA AS FACTORS IN THE REGULATION OF METABOLISM G. Gardos p 61–78 refs
4. GROWTH CONTROL A. Garay p 79–100 refs
5. CONTROL OF CELL DIVISION AND GROWTH G. Rappay p 101–117 refs
6. GENETIC CONTROL OF ENZYME SYNTHESIS G. Denes p 118–135 refs

N64-30782 California U., Berkeley Lawrence Radiation Lab.
SUPPLEMENT TO BIOLOGY AND MEDICINE SEMIANNUAL REPORT, SPRING 1964
[1964] 56 p refs
(Contract W-7405-ENG-48)
(UCRL-11387, Suppl.) OTS: $1.25

CONTENTS:

1. ON THE SPATIAL DISTRIBUTION OF RADICALS PRODUCED BY IRRADIATION S. J. Wyard 7 p refs (See N64-30783 22-07)
2. EPR STUDIES ON OH RADICAL IDENTIFICATION IN IRRADIATED H_2O T. E. Gunter and C. D. Jeffries 6 p refs (See N64-30784 22-07)
3. ELECTRON MICROSCOPY OF SINGLE-STRANDED DNA: CIRCULARITY OF ϕX-174 DNA D. Freifelder, A. K. Kleinschmidt, and R. L. Sinsheimer 5 p refs (See N64-30785 22-16)
4. INACTIVATION AND RECOVERY OF MICROORGANISMS AFTER TREATMENT WITH ULTRAVIOLET LIGHT OR OTHER MUTAGENS R. H. Haynes 34 p refs (See N64-30786 22-16)

N64-30785 California U., Berkeley Lawrence Radiation Lab.
ELECTRON MICROSCOPY OF SINGLE-STRANDED DNA: CIRCULARITY OF $\phi\chi$-174 DNA
David Freifelder, Albrecht K. Kleinschmidt, and Robert Sinsheimer (Calif. Inst. of Tech.) *In its* Suppl. to Biol. and Med. Semiann. Rept., Spring 1964 [1964] 5 p refs Partially Sponsored by NASA (See N64-30782 22-16) OTS: $1.25
(Contracts NIH-AI-01267; NIH-CA-02245)

Direct observation of DNA molecules by electron microscopy is possible if the DNA is adsorbed onto protein monolayers. DNA of ϕX-174 was prepared according to the method of Sinsheimer, and was adjusted to a concentration of 70μg/ml in 0.1 M Tris, pH 7.7. Representative single-stranded rings of ϕX-174 DNA are shown. In a typical field, about half of the DNA is easily seen as circular molecules, with filaments accounting for fewer than 2%. The remainder of the DNA consisted of molecules overlapping, aggregated, or tangled. From the results of electron-microscopy observations, it is concluded that ϕX-174 DNA is circular as well as single-stranded. P.V.E.

N64-30786 California U., Berkeley Lawrence Radiation Lab.
INACTIVATION AND RECOVERY OF MICROORGANISMS AFTER TREATMENT WITH ULTRAVIOLET LIGHT OR OTHER MUTAGENS
Robert H. Haynes *In its* Suppl. to Biol. and Med. Semiann. Rept., Spring 1964 [1964] 34 p refs Presented at the NAS-NRC Symp. on Mol. Mech. in Photobiology, Wakulla Springs, Fla. Feb. 1964 (See N64-30782 22-16)
(Grant NIH-GM-10877) OTS: $1.25

The apparent major cause of death in bacteria treated with ultraviolet light, X-rays, or nitrogen mustard (HN2) is described. These agents produce structural defects in DNA that, unless repaired, are likely to inhibit DNA synthesis or cause some error in protein synthesis, which leads to cell death. Survival is determined by the net probability that these defects either persist and prove lethal or are repaired after irradiation during the first few hours of incubation on the plating medium. P.V.E.

N64-30791* Chicago U., Ill. Committee on Biophysics
NEW APPROACHES IN CORRELATIVE STUDIES OF BIOLOGICAL ULTRASTRUCTURE BY HIGH-RESOLUTION ELECTRON MICROSCOPY
H. Fernandez-Morán Repr. from J. Roy. Microscop. Soc., v. 83, pts. 1–2, Jun. 1964 p 183–195
(Grants NsG-441-63; NIH-B-2460; NIH-C-3174; NIH-NB-04267; Contract AT (30-1)-2278)

Representative examples that illustrate characteristic features of new methodological approaches in correlative studies of native biological systems are briefly reviewed. The following are discussed: (1) fine structure of the nerve myelin sheath; (2) electron-microscope and X-ray diffraction studies of crystalline insect virus inclusions; (3) correlation of ultrastructure and function in mitochondrial membranes; (4) electron microscopy of negatively stained solubilized liquids; (5) correlated electron microscopic and biochemical studies of the *E. Coli* pyruvate dehydrocenation complex; (6) study of biological systems at liquid-helium temperatures; (7) general design concepts of a cryoelectron microscope that uses superconducting electromagnetic lenses. P.V.E.

N64-30859 Kentucky U., Lexington Medical Center
STUDY OF METHODS OF ASSESSMENT OF PERIPHERAL RESPONSES TO HEAT AND COLD AS INFLUENCED BY ENVIRONMENT Annual Progress Report, 1 Nov. 1963–31 Jul. 1964
Loren D. Carlson [1964] 16 p
(Contract DA-49-193-MD-2519)
(AD-603074) OTS: $1.00

The work in this continuing project has proceeded in three phases. Phase I is concerned with the standardization of methods for assessing physiological responses to cold and the general fitness of the individual. Phase 2 is concerned with equipment development for field work using the methodology for the proposed International Biological Program. Phase 3 is concerned with investigating the influence of the level of body-heat content and heat production on the responses of peripheral circulation with the consequent heat loss. A bath calorimeter has been used, and the studies outlined in this report relate heat production, heat loss, and heat debt to the skin temperature in the hand and arm when they are extended from the bath. I.v.L.

N64-30975 Stanford U., Calif.
THE CALORIC COST AND FLUID AND ELECTROLYTE BALANCE IN SIMULATED SUBARCTIC SURVIVAL SITUATIONS
T. A. Rogers, J. A. Setliff, and J. C. Klopping Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Dec. 1963 52 p refs
(Contract AF 41(657)-364)
(AAL-TDR-63-16; AD-605255)

Field investigation was undertaken to determine the physiological changes concomitant with starvation in an arctic or subarctic environment. The results of these experiments indicate that man increases his caloric expenditure to 2,300 kcal/M^2/24 hr, as is expected, but that he also displays a severe dehydration. This dehydration is accompanied by a marked loss of electrolytes, primarily sodium, and it is this isotonic dehydration that causes the severe malaise and apathy typical of starvation in the cold. The Integrating Motor Pneumotachograph is presented, and its use as a device to measure caloric expenditure is described. Author

N64-31026* Melpar, Inc., Falls Church, Va.
REVIEW OF CONCEPTS AND INVESTIGATIONS FOR THE USE OF OPTICAL ROTATION AS A MEANS OF DETECTING EXTRATERRESTRIAL LIFE
Ira Blei and J. W. Liskowitz [1964] 15 p refs Presented at Fifth Intern. Space Sci. Symp. (Cospar), Florence, 8–20 May 1964
(Contracts NASr-85; NASw-557)

To achieve the greatest sensitivity, the method developed to measure optical activity had to be capable of detecting a signal at the absorption maximum where attenuation of transmitted light is greatest. This required the use of symmetrical angles where two polarizing prisms are set at fixed angles, $(+\theta)$ and $(-\theta)$, about the optic axis of an analyzer prism. Results indicate that optical activity associated with material closely related to nucleotides can be extracted from soil with neutral and, more efficiently, with aqueous alkaline washes. A.W.

N64-31031 Florida State U., Tallahassee Inst. of Molecular Biophysics
RESEARCH IN PHOTOBIOLOGY AND PHOTOCHEMISTRY Final Report, 1 Apr. 1963– Apr. 1964
Hans Gaffron 23 Jun. 1964 7 p refs
(Grant AF-AFOSR-62-190)
(AFOSR-64-1192; AD-602756) OTS: $1.00

Abstracts of the following research are presented: (1) flavin-sensitized photoreactions—effects of 3-(p-chlorophenyl)-1,1-dimethylurea; (2) photochemistry and metal catalysts—studies on a flavin-sensitized oxidation of ascorbate; (3) the role of light in evolution—the transition from a one-quantum to a two-quantum mechanism; (4) light-induced acetate assimilation in *Chlamydobotrys* and in other green algae (e.g. *Scenedesmus*); and (5) the investigation of the simultaneous release of hydrogen and oxygen from adapted algae in the presence of light, when carbon dioxide is absent. I.v.L.

N64-31035 Rochester U., N.Y. Miscellaneous Research Div.
IRREPARABLE INJURY FROM PROMPT RADIATION DOSES AS MEASURED BY PROTRACTED DOSES IN MICE
Henry A. Blair 11 Sep. 1964 26 p refs
(Contract W-7401-ENG-49)
(UR-649)

Experiments on mice are examined in which evenly divided or protracted exposures (resulting in death from ionization radiation) of at least 50 r per day are used to measure the long-lasting effect (irreparable injury) from a prior prompt dose or a series of doses. Because the total dose of the protracted test exposure is reduced in proportion to the prior test exposure, it is concluded that the irreparable injury from either exposure is proportional to dose. However, the data, as measured, give a value about 2.6 for the ratio of irreparable injuries of prior to test dose. Because this ratio is probably unity, the difference is attributed to the experimental method of continuing the test exposure to actual death, instead of stopping earlier in anticipation of 30-day death. Author

N64-31050 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
A SIMPLE, INEXPENSIVE WAY TO MONITOR ELECTROCARDIOGRAMS ON AN ACTIVELY EXERCISING SUBJECT
Kenneth H. Cooper Aug. 1964 14 p refs
(SAM-TDR-64-38; AD-447979)

A simple, inexpensive means of obtaining excellent ECG recordings on an actively exercising subject is described. The recordings compare favorably with one of the standard precordial leads both in wave configuration and amplitude and have been used successfully in monitoring subjects during various physical exercises. Changes in the RS-T segment during exercise are readily apparent owing to the normal takeoff of the ST segment. Muscle interference is not routinely a problem unless the exercise requires contraction of the muscles in the arm. Author

N64-31051 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
SOUND TRANSMISSION IN HELIUM AND VARIOUS GASES AT LOW PRESSURES
Julian P. Cooke Aug. 1964 13 p refs
(SAM-TDR-64-43; AD-447980)

This investigation was concerned with the following: (1) the attenuation of sound in atmospheres of room air, 100% nitrogen, oxygen, or helium, and a 50-50 helium–oxygen mixture at reduced barometric pressures; and (2) a pilot study in evaluating oral communications in a 50–50 helium–oxygen atmosphere at a reduced barometric pressure. Reference tables have been prepared to assist in estimating the degree of sound reduction that will take place in each gas or gas mixture at different reduced barometric pressures. The pilot sound study has shown that tonal modification in the helium–oxygen atmosphere does not result in unintelligible oral communications at 395-mm Hg atmospheric pressure. Author

N64-31052 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
EFFECTS OF ARGININE, L-GLUTAMATE, AND PYRIDOXINE ON THE TOXICITY OF AEROZINE
Miguel A. Medina Aug. 1964 7 p refs
(SAM-TDR-64-49; AD-447981)

The toxicity of the rocket propellant Aerozine, a mixture of hydrazine and 1,1'-dimethylhydrazine (UDMH), was investigated in rats. It was found that Aerozine has an LD_{50} of approximately 120 mg/kg and produced severe convulsions within 30 minutes after intraperitoneal injection. Administration of a mixture of arginine–glutamate (4 mM/kg) and pyridoxine (0.5 mM/kg) produced a significant reduction of deaths in rats given 130 mg/kg of Aerozine. This antidotal combination was not as effective when glutamate was omitted, and injections of arginine–glutamate, glutamate–pyridoxine, arginine, l-glutamate, or pyridoxine alone did not afford any protection. Author

N64-31053 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
PAROTID FLUID CORTICOSTEROID LEVELS AT ONE AND TWO HOURS AFTER GRADED DOSES OF ACTH
Ira L. Shannon, John R. Prigmore, and Steven C. Beering Aug. 1964 7 p refs
(SAM-TDR-64-50; AD-448081)

Parotid-fluid and serum-free 17-hydroxycorticosteroids were measured in 80 apparently normal young adult males who received graded intramuscular doses of ACTH-gel. Parotid-fluid steroid levels increased significantly at one hour after dosage for those receiving 5, 10, or 20 units of ACTH. For the two latter groups the levels remained significantly elevated at two hours after ACTH. Serum-free 17-OHCS levels at two hours after dosage increased steadily with the increase in amount of ACTH administered. These results substantiate the premise that parotid fluid steroid levels may be employed to assess adrenocortical status. Author

N64-31054 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
VACUUM ADAPTATION OF BASEPLATE MATERIALS
James M. Terry and Roy Wahlberg Aug. 1964 12 p refs
(SAM-TDR-64-51; AD-448073)

A vacuum method for the adaptation of base-plate materials to dental casts was developed and compared to the conventional method of manual adaptation. A statistically significant saving of time resulted from the use of the vacuum method. The Contourator (model B) was employed to demonstrate the degree of adaptation provided by the test procedures. More intimate adaptation of the base-plate material to the cast and to the test die was obtained when the vacuum method was employed. Author

N64-31059 Rochester U., N.Y. Atomic Energy Project
THE USE OF GLASS MICRODOSIMETER RODS IN THE DETERMINATION OF ENERGY AND DOSE WITHIN TISSUE
H. D. Maillie and H. Mermagen 28 Aug. 1964 26 p refs
(Contract W-7401-ENG-49)
(UR-651)

A technique is described that will predict, with a reasonable degree of accuracy (±10%), the dose delivered to any point within a phantom exposed to photon energies from a 1000-kV-peak X-ray unit or to Co^{60} γ-radiation. The dosages predicted from the combination of the effective energy and the relative response of the lucite-covered microdosimeter rods used in the technique agree, within the limits of accuracy of the technique, with dosages determined by means of a Victoreen R-chamber. From this agreement, it is concluded that the predicted effective energies are valid. The method described will permit a determination of the effective photon energy within an irradiated mass of any construction, as well as of the exposure dose (in roentgens). Knowing the mass-energy absorption coefficient of the tissue in question, the absorbed dose in rads can be calculated. P.V.E.

N64-31073 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AEROSPACE MEDICINE
Stanko Plevnik 19 Aug. 1964 12 p refs Transl. into ENGLISH from Lijecnicki Vjesnik (Yugoslavia), v. 85, no. 5, 1963 p 489–495
(FTD-TT-64-203/1; AD-447338)

The rise of space biophysics to deal with problems presented by man's attempts to conquer outer space is described. The medical problems presented by manned space flights are discussed, with special emphasis on weightlessness and radiation hazards. A.W.

N64-31074 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
JOURNAL OF PHYSIOLOGY Selected Articles
12 Aug. 1964 21 p refs Transl. into ENGLISH from Fiziol. Zh., Akad. Nauk Ukr. RSR (Kiev), v. 9, no. 2, 1963 p 151–157; 273–276
(FTD-TT-64-386/1+2; AD-447341)

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1. ON THE PRINCIPLE OF THE PHILOSOPHICAL PROBLEM OF BIOLOGICAL CYBERNETICS M. L. Gorbach p 1–12
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3. RECORDING NYSTAGMUS WITH THE AID OF A STRAIN GAUGE AND AN OSCILLOGRAPH V. T. Khlebas, N. P. Kozhukhar, and I. F. Sokolyanskiy p 15–18

N64-31084 Northrop Corp., Hawthorne, Calif. Space Labs.
MODEL ASTRONAUT RADIATION DOSE DISTRIBUTION ANALYSIS Technical Documentary Report, Jul. 1963–Sep. 1963
R. E. Fortney and G. E. Duckworth Wright-Patterson AFB, Ohio, AMRL, Feb. 1964 27 p refs
(Contract AF 33(657)-11010)
(NSL-63-172; AMRL-TDR-64-9; AD-435734)

Radiation tolerance levels vary for the different vital body organs and, therefore, the radiation dose distribution in an astronaut may be critical in future space endeavors. This study was initiated to determine analytically the dose distribution inside a model astronaut. The basis of the mathematical formulation for determining this distribution is presented. Particles of the ambient environment were assumed to impinge isotropically on the Apollo Command Module (CM). The radiation was attenuated through a typical vehicle wall thickness, and mean dose rates at various depths in a model astronaut were calculated. Four depths were investigated, each having approximately 175 points at which the dose was calculated. Two spectra were considered; one for Van Allen protons and the other representing solar flare protons. The results are presented in graphical form, giving dose versus depth in the model astronaut. Author

N64-31103 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PHYSIOLOGICAL JOURNAL OF THE USSR Selected Articles

10 Sep. 1963 15 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 49, no. 7, 1963 p 870–872, 886–888
(FTD-TT-63-849/1+2; AD-420615)

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1. QUANTITATIVE CHARACTERISTICS OF VASCULAR REACTION IN PLETHYSMOGRAPHIC INVESTIGATIONS Yu. I. Krasil'nikov p 1–6 refs (See N64-31104 22-16)

2. METHOD OF PHYSIOLOGICAL RESEARCH: ATTACHMENT FOR RECORDING PRESSURE, VOLUMETRIC PULSE, AND MECHANOGRAMS ON THE MPO-2-OSCILLOGRAPH N. N. Vasilevskiy and O. Ye. Guzeyev p 7–12 ref (See N64-31105 22-16)

N64-31104 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

QUANTITATIVE CHARACTERISTICS OF VASCULAR REACTION IN PLETHYSMOGRAPHIC INVESTIGATIONS

Yu. I. Krasil'nikov *In its* Physiol. J. 10 Sep. 1963 p 1–6 refs (See N64-31103 22-16)

The pronounced vascular reactions due to the mucous membrane of the nasal cavity were investigated in persons suffering with chronic tonsilitis. It was established that, under the action of a cold stimulus, the constriction of the vessels depends on the individual sensitivity of the subject investigated, on the original state of the vascular lumen, and also on the temperature and duration of the action of the stimulant. The more sensitive the person is to cold and the less he is trained and adapted to the effects of cold, the more pronounced will be the spasm of the vessels. Persons suffering with chronic tonsilitis have an enhanced sensitivity to the cooling action of distant parts of the skin. The individual sensitivity to cooling in the investigated subjects, and the peculiarity of the responsive vascular reaction due to the mucous membrane of the nasal cavity were studied in the form of a plethysmographic curve by comparing two interrelated values—the height of the pulse wave and the drop in the curve registering the degree of vascular constriction. I.v.L.

N64-31105 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

METHOD OF PHYSIOLOGICAL RESEARCH: ATTACHMENT FOR RECORDING PRESSURE, VOLUMETRIC PULSE, AND MECHANOGRAMS ON THE MPO-2 OSCILLOGRAPH

N. N. Vasilevskiy and O. Ye. Guzeyev *In its* Physiol. J. 10 Sep. 1963 p 7–12 ref (See N64-31103 22-16)

An optical airmanometer (pneumovibrator), developed for the oscillograph MPO-2, is mounted inside the body of the standard vibrator of the oscillograph. Its main element—the hermetically sealed capsule with a corrugated membrane of polystyrene—is fastened firmly on a base. One end of an elastic, thin, and narrow band is fastened to the center of the membrane, and the other end is fastened to the base. A mirror is attached to the bend in this strip; the bend is opposite a window in the body of the vibrator. When the pressure inside the capsule increases, the membrane bends, and this motion is transmitted to the mirror. The mirror turns on its axis and changes the direction of a reflected ray of light. Applications of the pneumovibrator include these: (1) the recording of the form of the volumetric pulse of the radial and carotid arteries in man; (2) the recording of a finger plethysmogram; (3) the recording of the absolute values of pressure, whether arterial, venous, cerebrospinal, or intraocular; and (4) the recording on an oscillogram of different mechanical processes—movement of the thorax, beating of the heart, motion of the lower jaw and extremities, contraction of the separate muscles, etc. I.v.L.

N64-31175 Naval Radiological Defense Lab., San Francisco, Calif.

AROUSAL REACTIONS WITH A BRIEF PARTIAL- AND WHOLE-BODY X-RAY EXPOSURE

E. L. Hunt and D. J. Kimeldorf 23 Sep. 1963 16 p refs
(USNRDL-TR-670; AD-421070)

A study was made to determine the sensitivity of the mammalian nervous system to nonvisual stimulation with ionizing radiation. Blinded rats were exposed, while asleep, to a one-second burst of X-rays, and measurements of behavioral arousal and heart rate were made to indicate activation of the central nervous system. The stimulus was immediately effective since reaction latencies of one second or less were frequently recorded. The relative incidence of arousal and of a heart rate reaction was found to be related to the radiation dose rate over the range of from 0.05 to 3.2 r/sec. The threshold dose rate was less than 0.05 r/sec. To test for regional distribution of sensitivity, additional blinded animals were exposed to a burst of X-rays at the dose rate of 1.0 r/sec with exposure limited to the head region or to the rest of the body. Since arousal was elicited with exposure of either region, it is evident that sensitivity to X-ray stimulation is widely distributed.
Author

N64-31219* Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

SPACE-CABIN ATMOSPHERES, PART I: OXYGEN TOXICITY A Literature Review

Emanuel M. Roth Washington, NASA, 1964 59 p refs Sponsored by NASA Previously announced as NASA-TN-D-2008; see N63-20754 21-16
(NASA-SP-47) GPO: $0.40

The review is divided into the following areas: (1) molecular mechanisms of oxygen; (2) the effects of high oxygen tension in animals; (3) the effects of high oxygen tension in human beings; (4) oxygen-produced atelectasis; (5) the combination of oxygen toxicity and blast effects; (6) oxygen in space-radiation problems; (7) drug therapy as protection against oxygen toxicity; and (8) the role of oxygen toxicity in selection of space-cabin atmosphere. P.V.E.

N64-31267 Joint Publications Research Service, Washington, D.C.

CHROMIUM COMPOUNDS POISONING

Ya. M. Grushko 7 Oct. 1964 35 p Transl. into ENGLISH from the book "Soyedineniya Khroma i Profilaktika Otravleniy" Moscow, 1964 p 30–45, 138–156, 302–304
(JPRS-26768; TT-64-51025)

The chapters presented cover the following: Paths of Entry of Chromium into the Organism, Accumulation of Chromium in the Organism, Removal of Chromium from the Organism During Poisoning, and Morbidity of Workers in Contact with Chromium. Author

N64-31313 Joint Publications Research Service, Washington, D.C.

CURRENT CONCEPTS OF MECHANISMS OF THE PROTECTIVE EFFECT OF CHEMICAL COMPOUNDS AGAINST RADIATION

V. A. Baraboy 12 Oct. 1964 42 p refs Transl. into ENGLISH from Usp. Sovrem. Biol. (Moscow), v. 58, no. 1 (4), Jul.–Aug. 1964 p 52–73
(JPRS-26842; TT-64-51099) OTS: $2.00

Presented is a survey of literature concerned with the basic mechanisms of various chemicals giving antiradiation protective effects along with the chemical properties of the various preparations and their chemical structure and pharmacological properties. The mechanisms involved on three different biological levels are considered—atomic-molecular level, cell level, and organism level. P.V.E.

N64-31315 Mississippi State U., State College
PHYSICAL, CHEMICAL, AND MICROBIOLOGICAL EVALUATION OF ELECTROCHEMICAL DEGRADATION OF HUMAN WASTES Informal Progress Report No. 8, 1 Apr.–30 Jun. 1964 30 Jun. 1964
Robert G. Tischer [1964] 29 p
(Contract AF 41(609)-1633)
(AD-447801)

Microelements normally used in Knop's medium were added independently to 120 hour 1/10 EDO. With the exception of manganese chloride, the increase in dry weight of cells when each was used was about the same as plain EDO. But the medium with manganese-added chloride increased the dry weight of cells as much as the EDO control with all the microelements added. Factors studied might limit the growth of *Chlorella* 71105 in the EDO and demonstrate whether a deficiency or toxicity exists. It was determined that moderate amounts of total Kjeldahl nitrogen, nitrates, chlorides, orthophosphates, and sulfates remained in 72-hour 1/10 EDO after 48 hours' growth, when employed as an algal medium; it is evident that a shortage of one of the components investigated is not responsible for the limited growth of *Chlorella* 71105. An investigation was made to determine whether selected cations plate out on the cathodes during electrolysis of DO. To separate the evolved gases and to study the anode and cathode reactions individually, experiments were performed with a U tube as the electrolysis vessel R.L.K.

N64-31319 Rochester U., N.Y.
THE FATE OF RADON INGESTED BY MAN
John B. Hursh, Donald A. Morken, Thomas Davis, and Arvin Lovaas 10 Jul. 1964 43 p refs
(Contract W-7401-ENG-49)
(UR-648)

Four experiments were performed in which two subjects on two occasions drank approximately 1μc radon plus daughters in 100 ml of water. Measurements on radon loss in expired air, whole body radium C content, and radon in the blood permit the calculation of an $(MPC)_w$ of 2.0×10^{-4} μc/ml for occupational exposure. This is based on the stomach as the critical organ, but doses to the lung, kidney, and liver are estimated. Author

N64-31338* National Aeronautics and Space Administration, Washington, D.C.
USING RADIOTELEMETRY TO INVESTIGATE GASTRIC EVACUATION [PRIMENENIYE RADIOTELEMETRII DLYA ISSLEDOVANIYA EVAKUATORNOY FUNKTSII ZHELUDKA]
Ye. B. Babskiy, A. S. Belousov, I. I. Malkiman, A. P. Nesterova, and A. S. Sorin Aug. 1964 4 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 3, 1964 p 719–720
(NASA-TT-F-9060) OTS: $1.00 fs; $0.50 mf

Data are presented that show that a pH radiocapsule attached to the end of a duodenal tube can be used to investigate gastric evacuation in healthy persons, as well as in patients. Patterns of pH variation in time in a healthy person and in a patient with duodenal ulcer are given, and it is concluded, after studying five such patients, that their gastric-evacuation function was impaired and that the secretion of their gastric glands was more rapid than that in healthy persons. D.E.W.

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-30226 Joint Publications Research Service, Washington, D.C.
EFFECTIVENESS OF AUTOMATIC CONTROL SYSTEMS
I. D. Kochubiyevskiy *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 191–200 refs (See N64-30207 22-01) OTS: $6.00

By effectiveness of automatic control systems is meant the guarantee with definite probability that the system will satisfy a given value of a quality criterion. It is shown that this probability is equal to the probability that the parameter values of the elements of the automatic control system belong to the region determined by the properties of the system structure and the required level of quality criterion. Author

N64-30369 National Research Council of Canada, Ottawa
QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 OCTOBER–31 DECEMBER 1963
[1963] 108 p refs
(DME/NAE-1963(4))

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1. INTRODUCTION TO NUMERICALLY-CONTROLLED THREE-AXIS MACHINE TOOLS J. C. Duffield and A. Bowker (Natl. Aeron. Estab.) p 1–21 (See N64-30370 22-17)
2. MAGNETOMETER INSTALLATION IN A NORTH STAR AIRCRAFT W. M. Strome (Natl. Aeron. Estab.) p 23–30 refs (see N64-30371 22-15)
3. THE GENERATION OF STATIC ELECTRICITY DURING AIRCRAFT REFUELLING L. Gardner (Natl. Res. Council) p 31–61 refs (See N64-30372 22-17)
4. CURRENT PROJECTS OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT p 63–109

N64-30370 National Aeronautical Establishment, Ottawa (Canada)
INTRODUCTION TO NUMERICALLY-CONTROLLED THREE-AXIS MACHINE TOOLS
J. C. Duffield and A. Bowker *In* Natl. Res. Council of Can. Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab., 1 Oct.–31 Dec. 1963 [1963] p 1–21 (See N64-30369 22-17)

Positional control units direct movement from one numerically defined point to another for machines where punching, drilling, boring, or welding is done at discrete positions. Continuous contour-control systems guide the moving members through a number of discrete positions, effecting a continuous control on its path. These systems are used with machines that produce contoured parts, such as contour mills and lathes.

In the first stage of numerical control systems, the procedures to be used and the path patterns are programed. This numerical information is converted into a signal for each controlled axis of the machine. The final stage consists of producing the actual motion of the machine-tool slides to correspond to the signals. The operation of a numerically controlled bridge-type milling machine equipped with contour control is described. This machine is profiling equipment for the manufacture of large wind-tunnel models. Mention is made of difficulties in early machine models, but the use of solid-state systems should eliminate dirt problems and assure positive, reliable operation. R.L.K.

N64-30372 National Research Council of Canada, Ottawa Div. of Mechanical Engineering
THE GENERATION OF STATIC ELECTRICITY DURING AIRCRAFT REFUELLING
L. Gardner *In its* Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab., 1 Oct.–31 Dec. 1963 [1963] p 31–61 refs (See N64-30369 22-17)

A full-scale program was set up to determine the effect of low temperatures on the electrostatic charging and discharging processes encountered during aircraft refueling. The main observations were these: (1) a strong reduction in fuel conductivity during and after transfer of fuel through the fueling equipment; (2) a strong increase in charge concentration when dual filtration was used; (3) in the normal runs, field strengths over 400 kv/m., followed by discharges in the tank's vapor space, up to a rest conductivity of 7 picomho/m.; (4) most discharges occurring in the final stage of filling the tank, however, with some being detected in the initial stage of filling; (5) most discharges being weak, but some strong enough to ignite a flammable air/fuel mixture; (6) high field strengths measured in a small experimental tank, in the T-33 wing-tip tank, and in the Yukon tank, with positive evidence of discharges in the first two types; and (7) the effectiveness of a static charge dissipating additive in giving protection against static hazards. A general picture is presented of the present-day knowledge of the electrostatic charging and discharging processes in relation to aircraft refueling. Methods of reducing electrostatic hazards are discussed. R.L.K.

N64-30439 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
COMPATIBILITY OF MPD REFRACTORY MATERIALS WITH CESIUM VAPOUR
G. Arthur *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 13 p refs Presented at the Internatl. Symp. on Magnetohydrodyn. Power Generation, Paris, Jul. 1964 (See N64-30427 22-24) OTS: $6.00

Investigation of the resistance to cesium vapor of various electrode and insulant materials is discussed. Materials exposed to cesium vapors at high temperatures and pressures included boron nitride, graphite, silicon carbide, alumina, hafnia, zirconia, molybdenum, tantalum, and tungsten. Conclusions reached included the following: (1) Alumina and hafnia are suitable closed-cycle MPD duct materials up to 1800° C. (2) Boron nitride, although altered by cesium at 1800° C, is not severely damaged, and the limitation on life would be the high rate of evaporation. (3) Of the electrode materials tested, molybdenum and tungsten were unaffected by heating in cesium to 1800° C. Tantalum was embrittled, but this may be due to oxygen and nitrogen pickup and not to cesium. P.V.E.

N64-30474 Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
PASSIVE THERMAL CONTROL COATINGS
J. E. Gilligan, M. E. Sibert, and T. A. Greening [1963] 45 p refs Presented at the Seventh Meeting of the Refractory Composites Working Group, Palo Alto, Calif., 12–14 Mar. 1963 (Contracts AF 04(647)-787; AF 04(695)-136)
(AD-602894)

Development of a unique class of coating materials for satellite passive temperature-control surfaces is described. Certain alkali silicate-based all-inorganic coating systems offer considerable promise for current long-term applications in this area of space technology. The major objective of this program was the development of coating systems with stable α/ϵ values of less than 0.30 after 2000 to 6000 sun-hour exposures under space environmental conditions, with lesser emphasis in systems with α/ϵ values of up to 1.20. D.E.W.

N64-30483 Oak Ridge National Lab., Tenn. Isotopes Div.
FABRICATION OF $^{137}C^{s}$ SOURCES
J. A. Jones Sep. 1964 20 p refs
(Contract W-7405-ENG-26)
(ORNL-3675) OTS: $0.50

Sealed sources containing $^{137}CsCl$ suitable for medical industrial, and research applications have been developed. The ^{137}Cs, separated from reactor fuel processing wastes, is prepared as $^{137}CsCl$ powder and pelleted under pressure into suitable shapes. The pellets are doubly encapsulated in stainless steel, sealed by fusion welding, and tested for leaks greater than 2×10^{-6} ml/sec. Author

N64-30495 Defense Dept., Washington, D.C. Office of the Director of Defense Research and Engineering
AEROSPACE LUBRICATION RESEARCH SURVEY
Donald B. Brooks Dec. 1962 22 p refs
(FL-210/48; AD-439678) OTS: $3.60

The results of a survey of firms conducting research into the problems of lubrication at extreme altitudes and in space are presented. Types of lubrication included in the survey were lubrication in high vacuum, gas-bearing lubrication, solid-film lubrication, lubricants for use in contact with liquid fuels and oxidants, and lubrication with closed-cycle turbine working fluids. Information presented includes the name of the firm doing work, environmental test range, and publications. P.V.E.

N64-30524* IIT Research Inst., Chicago, Ill. Technology Center
STABLE WHITE COATINGS Semiannual Report, Jan. 2–Jul. 2, 1964
Gene A. Zerlaut, Y. Harada, and J. H. Baldrige 13 Aug. 1964 86 p refs
(Contract NAS7-100; JPL-950746)
(NASA-CR-58814; IITRI-C6027-7) OTS: $3.00 fs; $0.75 mf

Investigations were conducted on three thermal-control coatings developed on a previous program for the Jet Propulsion Laboratory. The three compositions, all pigmented with SP500 zinc oxide, are a potassium silicate coating (Z93), a methyl silicone elastomer (S-13), and an experimental methyl silicone resin (S-33). Work was performed in the following areas: studies aimed at improving the engineering properties, such as storage; space-simulation experiments for investigating simulation variables, such as sample temperature and ultraviolet intensity; syntheses of methyl silicone resins; and studies of zinc oxide photolysis. Author

N64-30542 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CALCULATING THE FRICTION RESISTANCE OF A FLAT PLATE AT A ZERO ANGLE OF ATTACK IN THE REGION BETWEEN CONTINUUM AND A FREE-MOLECULAR FLOW
V. A. Sukhnev 24 Sep. 1963 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekh. Nauk; Mekh. i Mashinostr. (Moscow), no. 3, 1962 p 31–37
(FTD-MT-63-83/1+2+3+4; AD-439616)

The relationship of local and total friction coefficients of a flat plate in the areas of a flow with slip was investigated at Reynolds numbers $R \rightarrow 0$ and $R \rightarrow \infty$ values, coinciding with available solutions in the area of free molecular flow and in the continuum region. The relationship is derived on the basis of boundary-layer equations during usual boundary conditions, assuming that the depth of the pulse loss δ^{**} on the forward edge of the plate does not equal zero. Extrapolation of the obtained formula in the region of free molecular flow is used to determine the magnitude of δ^{**} as a function of the parameters of the incident flow. Further approximation gives the correlation between the drag coefficient of friction of an infinitely thin plate and the total drag coefficient of friction of a plate of finite thickness. These results are in good agreement with experimental data. M.P.G.

N64-30628 Chromalloy Corp., West Nyack, N.Y.
DEVELOPMENT OF A POWDER AND/OR GAS CEMENTATION PROCESS FOR COATING MOLYBDENUM ALLOYS FOR HIGH TEMPERATURE PROTECTION
Herman Blumenthal and Neil Rothman Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 87 p refs
(Contract AF 33(616)-7383)
(ML-TDR-64-74; AD-603021) OTS: $4.00

As prepared W-2 coating on Mo-0.5Ti was found to be essentially $MoSi_2$. Upon exposure at 2,700° F the coating becomes three phase and develops an oxidation-resistant glaze. A statistically designed experiment was run on two levels of each of nine process variables in order to optimize the W-2 coating process. This experiment indicated that the three most important process variables were time and temperature of processing and mixing of the coating powders. Soundness of the Mo-0.5Ti surface and acid etching of the surface were of secondary importance. Purity, particle size, and age of powder mixture and retort material were, statistically, minor in importance. Author

N64-30654 Sandia Corp., Albuquerque, N. Mex.
THE ECONOMICS OF QUALITY
David L. Field Sep. 1964 26 p refs
(SC-RR-64-1279)

Some basic economic concepts and principles are reexamined from the point of view of quality management, and a series of theoretical models are developed to demonstrate the application of economic analyses to quality situations. A few widely accepted but fallacious notions concerning quality practices performed in the name of economy are examined. Author

N64-30656 Joint Publications Research Service, Washington, D.C.
CERAMIC FLUX IN WELDING SOME ALLOYS
30 Sep. 1964 51 p refs Transl. into ENGLISH of 4 articles from the book "Svarka Spetsial'nykh Metallov i Splavov" Kiev, Izd. Akad. Nauk UKR. SSR, 1963 p 89–98, 111–136
(JPRS-26638; TT-64-41896) OTS: $3.00

CONTENTS:
1. CERAMIC FLUXES FOR AUTOMATIC WELDING OF ALLOYED STEELS D. M. Kushnerov p 1–13 refs
2. INVESTIGATION OF AUTOMATIC WELDING OF NICKEL HEAT-RESISTING ALLOYS UNDER CERAMIC FLUX D. M. Kushnerov and I. U. Lyakhovaya p 14–27 refs
3. WELDING WITH THE USE OF MAGNETIC CERAMIC FLUXES D. M. Kushnerov and V. G. Svetsinskiy p 28–39 refs
4. RESEARCH ON THE COMPOSITION OF A CERAMIC FLUX FOR AUTOMATIC WELDING OF DOUBLE-LAYERED ST.3 + 1Kh18N9T STEEL M. P. Grebel'nik p 40–50 refs

N64-30793 General Instrument Corp., Garden City, N.Y. Capacitor Div.
PRODUCTION ENGINEERING MEASURE FOR THE IMPROVED RELIABILITY OF CAPACITORS, FIXED SOLID ELECTROLYTE, TANTALUM HIGH-RELIABILITY 10MFD-20 VOLT CAPACITORS Quarterly Report, Dec. 29, 1963–Mar. 28, 1964
Floyd R. Banks, Jr. and A. D. Giacomo [1964] 18 p
(Contract DA-36-039-AMC-03622(E))
(QR-3; AD-602021)

Work was performed in the following areas: (1) anodizing and re-forming; (2) pyrolytic conversion; (3) carbon and silver coating; and (4) screening and dielectric absorption. The major results of the studies show that new anodizing racks and anodizing cathodes have provided high product uniformity and improved electrical characteristics over previous anodizing conditions. Conditions of both the flow and heat exchange of the conversion atmosphere and of the conversion times have been optimized, based upon the magnitudes of the final re-forming currents. The best electrical results, based upon comparative studies, have been obtained with three carbon coats applied to the anodes and extended carbon- and silver-coating curing cycles. Author

N64-30801 Hanford Atomic Products Operation, Richland, Wash.
THIN WALL TUBING TESTS USING ULTRASONIC SHEAR WAVES. PART II: PRODUCTION TEST EQUIPMENT, ITS OPERATION AND TEST RESULTS
M. F. Zeutschel and N. E. Dixon 30 Jun. 1964 48 p refs
(Contract AT (45-1)-1350)
(HW-81957) OTS: $1.25

The use of narrow-beam, broadband ultrasonic equipment for nondestructive testing of Zircaloy sheath tubing is reported. Axial and circumferential tests are performed simultaneously, using narrow-beam focused transducers that operate as both ultrasonic transmitters and receivers, propagating shear waves in the tube and receiving energy reflected from the tube surface and from defects when present. Using the recommended entry angles, defects from as small as 1 X 15 mils to as large as halfway through the tube were detected at continuously increasing amplitudes, regardless of their location in the tube wall. Good correlation was obtained between defect depth and the ultrasonic amplitude at which it was detected; the test was found to be quite insensitive to defect orientation. M.P.G.

N64-30904 Virginia U., Charlottesville Research Labs. for the Engineering Sciences
RESEARCH INVESTIGATION OF MAGNETIC AND ELECTRIC FORCES FOR ROTATING SHAFT SUSPENSION Technical Progress Report, Mar.–May 1963
B. J. Gilpin Jun. 1963 30 p
(Contract AF 33(657)-8352)
(EMI-4454-114-63U; AD-406286)

The radially passive bearing system is found to have an excessively flexible shaft. The system is rotated with an air turbine, and dynamic load tests show no coupling between a pure torque

load and the rigid body modes of the shaft. The completed mechanical system for the radially active bearing is given, and the modified current drivers are described. The continuing analysis and experimental effort to achieve damping in the resonant magnetic bearing system are given. Author

N64-30928 Marquardt Corp., Van Nuys, Calif.
APPLICATION AND EVALUATION OF REINFORCED REFRACTORY CERAMIC COATINGS Technical Documentary Report, Apr. 1961–Apr. 1962
Charles Kallup, Jr., Samuel Sklarew, and Stanley V. Castner Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 122 p refs
(Contract AF 33(616)-8209)
(ML-TDR-64-81; AD-604423)

Metal-reinforced refractory ceramic-coating systems have been developed to successfully withstand temperatures in excess of 4,000° F while providing insulative values for the supporting substructure. Eighty coating compositions were formulated and thermally evaluated in the plus 4,000° F range. Refractory coating of model nose cones and leading edges was accomplished by utilizing a vibratory casting technique, and the feasibility of this approach has been demonstrated. Twelve small-scale leading-edge models and six small-scale nose-cone models were coated, in addition to one 500 $in.^2$ leading edge and one 500 $in.^2$ nose-cone model. Thicknesses ranged from 0.3 to 0.75 in. Mechanical data and thermophysical properties of an advanced coating system were obtained. An up-to-date bibliography of reinforced refractory ceramic systems and allied subjects is included. Author

N64-30933 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio
DEVELOPMENT OF WELDING PROCEDURES AND FILLER MATERIALS FOR JOINING HIGH STRENGTH LOW ALLOY STEELS Technical Documentary Report, Jun. 1963–Jun. 1964
J. M. Faulkner, G. L. Hanna, and J. V. Peck Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1964 224 p refs
(Contract AF 33(657)-11229)
(ML-TDR-64-255; AD-605286)

A research program was conducted to develop welding procedures and filler materials for joining a martensitic and a bainitic steel having yield strengths of 180 to 200 ksi with adequate ductility and fracture toughness. The steels selected for this work were HP 9-4-20, a martensitic steel, and AMS 6435 austempered to produce a bainitic structure. Welding procedures were developed for gas tungsten-arc (TIG) and gas metal-arc (MIG) welding HP 9-4-20 plate and sheet material using filler wires of essentially matching compositions. TIG welds in the HP 9-4-20 plate and sheet material possessed excellent strength and ductility with fracture toughness comparable to the unwelded plate and sheet. MIG welds in the HP 9-4-20 plate failed to meet the basic program requirements. Procedures were developed for making MIG and TIG welds in AMS 6435 plate material, which was austempered at 575° F. Welds made at 4 ipm with a 575° F preheat and postheat for 2 hours met the 180-ksi yield-strength requirement. In no instance did the AMS 6435 weld joints meet the basic yield-strength requirement because of a serious loss in heat-affected zone strength due to overtempering. Author

N64-30935 Air Force Systems Command, Wright-Patterson AFB, Ohio Systems Engineering Group
X-20 (DYNA-SOAR) LANDING GEAR DEVELOPMENT AND QUALIFICATION PROGRAM
H. W. Howard Jun. 1964 30 p refs
(SEG-TDR-64-17; AD-603703)

A description of the X-20 landing gear and performance requirements are presented. The yielding metal energy absorption system and the all-skid concept is discussed. A summary is presented of the "energy strap" and skid development programs. The qualification program, which had not been initiated at the time of program termination, is discussed, and conclusions and recommendations are presented. Author

N64-30936 Air Force Systems Command, Wright-Patterson AFB, Ohio Materials Lab.
A REVIEW OF THE AIR FORCE MATERIALS RESEARCH AND DEVELOPMENT PROGRAM Technical Report, 1 Jul. 1962–30 Jun. 1963
Jun. 1964 293 p refs
(WADC-TR-53-373, Suppl. 10; AD-605386)

This report is a collection of abstracts covering a wide range of subjects in materials research. Among the areas covered are the following: (1) Materials—beryllium, high-strength metals, refractory-metal coatings, ceramics and cermets, elastomers, fibers, fuels, fluids, lubricants, graphite, plastics, and polymers; and (2) Testing—corrosion, creep, fatigue, stress, vibration, radiation, and heat transfer. E.K.R.

N64-30961 Beryllium Corp., Reading, Pa.
PRODUCTION ENGINEERING MEASURE FOR BERYLLIUM OXIDE AND PARTS PRODUCED FROM IMPORTED ORES Quarterly Progress Report, 1 Jan.–31 Mar. 1964
J. F. Blum and J. N. Wambold [1964] 45 p
(Contract DA-36-039-AMC-01481(E))
(QPR-3; AD-605182)

Pilot-plant studies show that a uniform beryllium oxide powder is produced by calcination of beryllium sulfate crystals, even though conditions are varied from run to run beyond normal production calcination operating limits. Dry blending, as an alternate process to the wet ball milling technique, was evaluated and found to produce parts with nonhomogeneous and unsatisfactory sintered density. Pits were prevalent throughout the body. Grade I and Grade V BeO were found to react similarly during dry blending and subsequent cold pressing and sintering. Extrusion process improvement was initiated, and a die with various size inserts is now available. The strength of the bond developed between the basic molybdenum–manganese metalizing layer and a 90% BeO body was evaluated and improved by altering the composition of the metalizing mixture. Author

N64-30967 Clevite Corp., Bedford, Ohio Piezoelectric Div.
PRODUCTION ENGINEERING MEASURE FOR CERAMIC FILTERS Quarterly Report, 30 Mar.–29 Jun. 1964
A. Lungo [1964] 23 p
(Contract DA-36-039-AMC-01471(E))
(Rept.-5; AD-605300)

The investigation of ring electrode application to the 4.3 Mc radial first overtone disk was completed. The results of the various techniques investigated are discussed. A different approach to the screening technique is described, which has improved the yield of 4.3 Mc disks having acceptable ring electrode patterns. The technique and initial results of tuning resonators for the 4.3 Mc filter requirements by tumble grinding are discussed. Difficulties encountered in the fabrication of the 6.0 Mc resonators are discussed. Author

N64-30969 Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.
DESIGN, DEVELOPMENT AND FABRICATION OF ULTRA HIGH STRENGTH SOLID PROPELLANT ROCKET MOTOR CASES Final Technical Report
E. P. Gilewicz Aug. 1964 195 p refs
(Contract AF 04(611)-9064)
(WAD-R-407F; RPL-TDR-64-114; AD-605477)

Specifications for materials were developed, materials were procured, tests were performed, and maraging treatment schedules were developed to maximize yield strength and fracture toughness. The biaxial strength of alloys heat treated by the optimum schedule was tested, and four full-scale motor cases were fabricated and tested. A complete description of the subscale and full-scale case designs, material evaluation, subscale fabrication and testing, and full-scale fabrication and testing, is presented. D.E.W.

N64-30974 Atlantic Research Corp., Alexandria, Va.
FEASIBILITY DEMONSTRATION OF PYROLYTIC GRAPHITE COATED NOZZLES Second Quarterly Progress Report, 1 May–31 Jul. 1964
James D. Batchelor 18 Aug. 1964 23 p
(Contract AF 04(611)-9708)
(RPL-TDR-64-129; AD-605422)

In the current work, nozzles of 1.1-in. and 2.3-in. diameter are to be tested with a 6,550° F propellant. Delamination cracks in coatings deposited on the subscale nozzle inserts continued to be a problem. In the second subscale motor test, a 66-mil coating was completely removed during the 83-sec firing. Coating failure by edge spalling was again indicated. Stress analysis of both free-standing and composite cylinders were carried out to define the effects of geometric variables, but no stresses were found to satisfactorily explain the observed cracks. Author

N64-30993* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
KINEMATIC ANALYSIS OF THE ENGINE AND PUMP INLET DUCT GIMBAL JOINT SYSTEM IN THE S-IC STAGE OF THE SATURN V VEHICLE
F. F. Garcia Washington, NASA, Oct. 1964 48 p refs
(NASA-TN-D-574) OTS: $1.25

A mathematical simulator of the engine and pump inlet duct gimbal joint system in the S-IC stage of the Saturn V vehicle was developed as a result of the kinematic analysis conducted. The simulator provided a convenient means and a precise method for determining the torsional, longitudinal, and bending deflections of the pump inlet ducts when the engine is gimbaled to its maximum limits. It is concluded that the torsional deflection of the pump inlet ducts in the S-IC stage of the Saturn V vehicle can be made to equal zero or can be reduced considerably by proper orientation of the three gimbal joints. Author

N64-30994* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
COMPARISON OF ABSOLUTE—AND REFERENCE-SYSTEM METHODS OF MEASURING CONTAINMENT-VESSEL LEAKAGE RATES
Edward G. Keshock Washington, NASA, Oct. 1964 19 p refs
(NASA-TN-D-1588) OTS: $0.50

The expressions for leakage used in the absolute- and reference-system methods are derived, discussed, and compared. It is concluded that no direct temperature measurements are required in the reference method. An error analysis is also performed that indicates the reference method to be the more accurate. In the most recent reactor-facility leak-rate tests an unusual method of measuring the vessel average air temperature was used. A 550-foot length of nickel wire was distributed about the vessel interior and employed as a resistance thermometer. Additional sets of temperature measurements were obtained by means of thermocouples, a platinum resistance thermometer, and a closed system of pressurized copper tubing that functions as a gas thermometer (reference system). Results were calculated from all sets of temperature measurements and compared. Author

N64-31019 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
INVESTIGATION OF THE STRENGTH OF LAMINATED MATERIALS WITH THE HELP OF PHOTOELASTICITY [FESTIGKEITSUNTERSUCHUNGEN AN VERBUNDKONSTRUKTIONEN MIT HILFE DER SPANNUNGSOPTIK]
Max Kufner London, Min. of Aviation, Aug. 1964 26 p refs
Transl. into ENGLISH of a paper presented at Intern. Symp. on Photoelasticity, Berlin, 10–15 Apr. 1961
(RAE-TRANS-1070)

After defining the concept of laminated materials, a law for models is deduced, and an ordered review of existing materials is given. Prestressed and reinforced concrete, dam walls, piles in foundations, and laminated beams with adhesive bonding are examples of the areas of research. Author

N64-31065 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Materials Processing Dept.
TUNGSTEN INSERT FIRING EVALUATION Interim Engineering Progress Report No. 1, 1 Feb.–31 May 1964
L. J. Stefan [1964] 15 p
(Contract AF 33(615)-1025)
(RTD-TR-7-797-A(I); AD-601966) OTS: $1.00

The design and assembly of the nozzles to be utilized in testing the first two W-2%Mo solid rocket nozzle inserts was completed. The inserts were closed die forged from stock that was vacuum centrifugal cast and extruded. Author

N64-31077 Atlantic Research Corp., Alexandria, Va.
CASTABLE CARBON FOR NOZZLE APPLICATIONS Second Quarterly Progress Report, Jun. 1–Sep. 1, 1964
James D. Batchelor Sep. 1964 11 p
(Contract AF 04(611)-9718)
(RPL-TDR-64-130; AD-447308)

The objective of this program is to demonstrate the advantages, in terms of fabrication simplicity and cost reduction, of a unique castable carbon material developed for rocket nozzle applications. To achieve this objective-materials studies and selection and the design and fabrication of nozzles for both a 5000-pound and 50,000-pound-thrust motor are to be carried out. To date, the first subscale nozzle (for the 5000 pound thrust motor) has been completed. Author

N64-31129 Inland Testing Labs., Dayton, Ohio Tech-Center Div.
QUARTZ CRYSTAL RELIABILITY STUDIES Quarterly Progress Report, 1 Apr.–1 Jul. 1964
Carleton E. Jones Ft. Monmouth, N.J., Army Electron. Res. and Develop. Lab., [1964] 40 p
(Contract DA-36-039-AMC-02350(E))
(Rept.-4; AD-446341)

The various factors that produce failure in military-type quartz-crystal units used in frequency-control applications are under investigation. The following crystals are checked for series resonant frequency and for resistance at various stages

of a 5,000-hr test run: CR-36A/U in type HC-6/U and type HC-27/U holders at 16 Mc/s; CR-47A/U in type HC-6/U holders at 253 kc/s; CR-18A/U in type HC-6/U holders at 1,000 kc/s; and CR-38A/U in HC-6/U holders at 80 kc/s. The quality and stability of the samples tested to date are considered to be exceptional. Except for five units (in glass enclosures) that developed cracked holders, there have been no catastrophic failures. P.V.E.

N64-31133 Arde-Portland, Inc., Paramus, N.J.
FABRICATION OF A 65.5 INCH DIAMETER SIMULATED ROCKET MOTOR CASE BY CRYOGENIC STRETCH-FORMING Technical Progress Report, May 1–Jul. 31, 1964
S. W. Henderson [1964] 18 p
(Contract AF 33(657)-9638)
(TPR-4; AD-444480)

Activities were directed at scaling up the equipment and techniques to handle the size and wall thickness of a big boost motor. Subscale efforts resulted in the following: (1) determination of proper weld bead configuration; (2) demonstration of room-temperature strength level of 282,000 psi in a cylindrical vessel; and (3) determination of a preform design that will provide an elliptical head in the stretched vessel. The results of materials tensile testing indicated the following: (1) The thickness variation has no appreciable effect on strength of cryogenically prestrained materials. (2) Aging the material 20 hr at 800° F increases the strength level to some 30,000 psi at room temperature. (3) Incorporation of welds does not materially affect the performance of the cryogenically prestrained material. (4) The material is more sensitive to notch defects when it is oriented with the rolling direction transverse to the direction of stress. R.L.K.

N64-31135 American Machine and Foundry Co., Alexandria, Va.
DEVELOPMENT OF MANUFACTURING METHODS FOR DEPOSITION FORMING Interim Progress Report, 1 May–31 Jul. 1964
M. E. Browning, W. H. Webster, Jr., H. W. Leavenworth, Jr., and F. J. Dunkerley [1964] 43 p refs
(Contract AF 33(615)-1375)
(IPR-2; AD-444204)

Process development work was continued for electroforming the cobalt–tungsten quaternary alloy and for depositing the dispersion-hardened nickel alloys by the electrocombination process. Studies made on operating variables of the cobalt–tungsten alloy bath included examining the effect of using high citrate concentrations in the bath, varying the content and ratios of W and Co, and evaluating the surface quality of deposits produced at various current densities. Work in the dispersion-strengthened nickel alloy area included examining the effect of several deposition parameters (viz. current densities, wetting agents, particle concentrations, etc.) on the resultant alloy. A new high-strength nickel bath was investigated, as well as two analytical techniques for determining particle concentrations in the deposited alloys. Author

N64-31153 Radio Corp. of America, Lancaster, Pa. Industrial Tube and Semiconductor Div.
DIELECTRIC TO METAL SEAL TECHNOLOGY STUDY Fourth Quarterly Report
A. C. Grimm and P. D. Strubhar Mar. 1963 85 p
(Contract AF 30(602)-2682)
(RADC-TDR-63-393; AD-419783)

The use of finer molybdenum, tungsten, and S-641A particle sizes in the metalizing inks employed in the sapphire-refractory metal seals was investigated. The strength of the seal obtained with the finer particle molybdenum and S-641A metalizing mixture obtained at 1700° C was equal to that obtained at 1750° C with the coarser powders. Structures resulting from the use of the finer particle molybdenum powders were better sintered but whether the seals are stronger has not been established. Definitely higher strengths and greater uniformity in seal strengths were obtained with the use of the finer tungsten powders. A new technique was developed for assembling fillet-free and void-free metalized ceramic windows. Vacuum-tight compression-band window assemblies have been made with all dielectric materials under investigation. Two materials, Pyroceram 9606 and beryllium oxide, have met the maximum bake temperature objective of 700° C. Seal sleeves of thicker copper and copper-plated stainless steel, Kovar, and nickel were evaluated for compression-band window assemblies. Author

N64-31159 Telecomputing Corp., San Diego, Calif. Narmco Research and Development Div.
SILICA FIBER FORMING AND CORE-SHEATH COMPOSITE FIBER DEVELOPMENT Quarterly Progress Report, 1 Jul.–30 Sep. 1963
R. B. Vidanoff 20 Oct. 1963 24 p
(Contract N600(19)59607)
(QPR-3; AD-421947)

Developments described in this report are as follows: (1) physical test results of continuous quartz fibers formed in argon from a tungsten bushing; (2) damaging effects to tungsten bushing; (3) effects of both argon and helium as atmospheres in drawing of quartz fibers; and (4) temperature and bushing hole size limits for fiberization. Author

N64-31168 Cornell U., Ithaca, N.Y.
FACTORS AND PROCEDURES FOR APPLYING THE MIL-STD-105D PLANS IN LIFE AND RELIABILITY INSPECTION
Henry P. Goode Sep. 1963 47 p refs
(Contract Nonr-401(43))
(TR-10; AD-421027)

Factors are provided for three alternative criteria for lot evaluation; mean life, hazard rate, and reliable life. Inspection of the sample is by attributes with testing truncated at the end of some preassigned period of time. The Weibull distribution, together with the exponential distribution as a special case, is used as the underlying statistical model. Author

N64-31184 Army Materials Research Agency, Watertown, Mass. Materials Testing Lab.
DEVELOPMENT OF IMPROVED ULTRASONIC BOND INSPECTION EQUIPMENT
Paul E. J. Vogel and Otto R. Gericke Oct. 1963 12 p
(AMRA-TR-63-16; AD-421879) OTS: $0.50

This report on the findings of a continuing project in the development of improved ultrasonic bond-inspection equipment includes a description of a small immersion tank for laboratory experimentation, an evaluation of certain focused immersion transducers, and a portrayal of bond flaws detected in laminations of materials having greatly dissimilar acoustical properties. Author

N64-31192 General Electric Co., Schenectady, N.Y. Research Lab.
AN INVESTIGATION OF THE NATURE OF STRUCTURAL DAMAGE IN METAL FORMING PROCESSES Progress Report No. 2, 18 Aug.–17 Oct. 1963
R. C. Leech, L. F. Coffin, and H. C. Rogers Oct. 1963 4 p refs
(Contract NOw-63-0671-c)
(Rept.-63-GC-0252M; AD-420280)

The sheet drawing device is shown isometrically with a strip specimen in place, and is then illustrated schematically to show how it will be positioned in a tensile-testing machine for the normal ambient experiments. A.W.

N64-31232 Hughes Aircraft Co., Culver City, Calif. Aerospace Group
DEVELOPMENT OF SELF-SEALANTS AND SEALANTS FOR AEROSPACE VEHICLES Third Quarterly Report, 15 Nov. 1962–15 Feb. 1963
A. J. Tuckerman and J. F. Yurk 1 Mar. 1963 38 p
(Contract AF 33(657)-9171)
(P-63-11; AD-419762)

A chemical self-sealant system has been developed that seals almost instantaneously a 0.140-in.-diam hole against a one atmosphere pressure differential over a 90° F temperature range (30° to 120° F). The system incorporates the polyamide reaction: sebacyl chloride and triethylene tetramine within the three-compartment package described previously. Author

N64-31250 Southwest Research Inst., San Antonio, Tex. Automotive Research Dept.
A STUDY OF THE BASIC MECHANISM OF DUST EROSION
Charles D. Wood Sep. 1963 58 p refs
(Contract DA-23-072-ORD-1375)
(AR-499; AD-420083)

This report presents the results of a study of the erosion of materials by airborne dust. Erosion rates for several metals were obtained over a wide range of dust particle velocity, particle angle of impact, dust particle size, and dust concentration. The experimental results show that for the range of variables studied, erosion occurs due to the plastic displacement of material by the dust particle. Relationships defining the effect of particle velocity and angle of impact upon erosion rates are given. Experimental data showing the effects of dust concentration, dust size distribution, and material properties on the rates of erosion are presented, and the mechanisms are discussed. Author

N64-31253 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio
RELIABILITY ANALYSIS USING FLOWGRAPHS
Thomas F. Oltorik (M. S. Thesis) Aug. 1963 52 p refs
(GRE/EE/63/3; AD-420047)

A reliability analysis of various integrant structures is performed using flow graphs. The flow graph representation of the reliability and effectiveness of a multimoded system is demonstrated. This solution provides a concise, pictorial illustration of the mathematical elements of the system. A Markov analysis of the multimoded system is performed by means of a Markov graph. This solution yields the state and transitional probabilities of moving from one mode or state to another. Flow graphs are used for a resource allocation problem to determine the cost and sensitivity of the system to changes in various parameters. Author

N64-31270 Argonne National Lab., Chicago, Ill.
DEVELOPMENT OF TECHNIQUES FOR FABRICATION OF SMALL-DIAMETER THIN-WALL TUNGSTEN TUBING Interim Progress Report, 1 Jul.–31 Dec. 1963
W. R. Burt, Jr., H. C. Katiyar (Atomic Energy Comm., Bombay), and R. M. Mayfield [1963] 41 p refs
(Contract W-31-109-ENG-38)
(ANL-6806) OTS: $1.00

Tungsten tubes suitable for secondary fabrication have been extruded from various starting materials. Pressed and sintered sleeves, vapor-deposited tubes, and preextruded tubes have been successfully manufactured. In addition, consolidation and extrusion of high-purity tungsten powder in a single extrusion show promise. Equipment, extrusion techniques, and results are described. Author

N64-31278 Rocketdyne, Canoga Park, Calif.
INVESTIGATION, DESIGN, AND TEST OF EXPERIMENTAL LIQUID HYDROGEN PUMPS Technical Report, 15 Nov. 1963–15 Feb. 1964
Mar. 1964 43 p refs
(Contract AF 33(657)-11165)
(R-5343-3; AD-447834)

Reported is the progress made on the study, design, and testing of an experimental liquid hydrogen pump for flight vehicle systems. The materials selection and the mechanical design and manufacture of a piston-type pump have been achieved to date. Author

N64-31283 Naval Radiological Defense Lab., San Francisco, Calif. Chemical Technology Div.
EVALUATION OF THE OXALIC ACID DOSIMETER FOR MEASURING MEGARAD DOSES OF GAMMA RADIATION
E. F. Connolly and L. H. Gevantman 5 Dec. 1963 13 p refs
(USNRDL-ER-14; AD-428607)

The oxalic acid dosimeter was tested in three γ-dose ranges: 1.6 to 6, 6 to 18, and 18 to 50 megarads. The results were found to agree within a $\pm 5\%$ to 10% experimental error with values extrapolated from measurements by the Fricke dosimeter. Author

N64-31287 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
HANDLING AND OPERATING INSTRUCTIONS FOR ROCKET MOTOR X258
P. Johnson May 1963 62 p
(Contract NOrd-16640)
(ABL/M-126; AD-439834) OTS: $6.60

A brief description of rocket motor X258 and the operating, handling, and storage instructions necessary for its proper use are given. The X258 rocket motor is a case-bonded, composite-modified, double-base solid-propellant system that used reinforced plastic and aluminum for all major inert components. The unit packages 506 pounds of propellant in 70 pounds of inert weight. Weight at burnout is approximately 63 pounds. P.V.E.

N64-31290 Boeing Co., Seattle, Wash. Aerospace Div.
INVESTIGATION OF SELF-ALIGNING BEARING MOUNTINGS FOR SPACE OPERATION Quarterly Progress Report, Sep. 1–Dec. 1, 1963
D. T. Jones, R. A. Kvinge, F. Schenk, and J. W. Van Wyk Dec. 1963 28 p refs
(Contract AF 33(657)-10422)
(QPR-3; AD-439857) OTS: $2.60

The major components of the self-aligning mountings and the mounting test fixtures were fabricated. Two in-air tests of one mounting concept were completed. One specimen failed after completing 487 cycles at −100° F. The second specimen successfully completed 750 cycles at −100° F but failed after 374 cycles at 1,500° F. Author

N64-31302 Lockheed-California Co., Burbank
WING BOX FUEL CONTAINMENT Fourth Quarterly Report, 1 Feb.–30 Apr. 1964

G. J. Kuka [1964] 85 p
(Contract AF 33(657)-11460)
(LAC/425741(A); LR-17879)

The loading, heating, and data-recording systems for testing the titanium static and fatigue box beam test specimens have been completed. Installation of the test specimens is shown. Trial elevated temperature tests have been conducted on both test specimens. Problems in heat control are being resolved to attain surface temperature uniformity. Author

N64-31307 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXIV: OXIDATION-RESISTANCE COATINGS FOR GRAPHITE Technical Documentary Report, Dec. 1961–Mar. 1963
D. A. Schulz, P. H. Higgs, and J. D. Cannon Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1963 118 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XXXIV; AD-606892)

The refractory materials that could be used for high-temperature, oxidation-resistant coatings for graphite are reviewed. A study of these materials shows those that are thermodynamically stable when applied directly to graphite and those that are thermodynamically stable when an intermediate coating is applied between an oxidation-resistant outer coating and the graphite. Calculations are made showing that, with properly selected intermediate reaction barriers, many very refractory oxides, such as thoria, can be used as coatings at temperatures up to their melting points. The application of TiB_2, B_6Si, $MgO{\cdot}ZrO_2$, $CaZrO_3$, and $SrZrO_3$ coatings by arc-plasma spraying is described, and the results of oxidation studies to determine the protection afforded graphite by these coatings are presented. Coating of TiC-TiN and SiC-Si applied to graphite by vapor deposition using the source-target method are discussed. Techniques of applying SiC coatings by pack-diffusion methods are reported, and the oxidation protection afforded by the coatings is compared with that of the SiC produced by the source-target method. Author

N64-31310 Rock Island Arsenal Lab., Ill.
SOLID FILM LUBRICANT SUBSTRATES
G. P. Murphy and F. S. Meade 6 Feb. 1964 18 p refs
(RIA-64-1377; AD-602718) OTS: $0.50

A comparison of the wear life and corrosion protective ability of a recently developed solid-film lubricant (RIA Compound 9A) and two commercial solid-film lubricants was made. The substrates to which the solid-film lubricants were applied were: (1) grit blasted steel; (2) zinc phosphatized grit-blasted steel; (3) zinc phosphatized cadmium-plated steel; and (4) sulfuric acid anodized water-sealed aluminum. Author

N64-31311 Joint Publications Research Service, Washington, D.C.
RELIABILITY OF THE MANUFACTURE OF ELECTRONIC COMPUTING MACHINES
P. P. Mesyatsev 5 Oct. 1964 73 p Transl. into ENGLISH of selected articles from the book "Nadezhnost' Proizvodstva Elektronno-Vychislitel'nykh Mashyn" Moscow, Mashgiz., 1963 p 3–16, 28–32, 97–102, 173–188, 196–213
(JPRS-26687; TT-64-41944) OTS: $3.00

Four chapters of a book that examines the problems connected with the reliable manufacture of electronic computers are presented. The chapters are concerned with the following: (1) presenting brief facts on electronic computers, both from the standpoint of their classification, areas of application, the makeup of the standard units from which the machine is built, and from the standpoint of the lines along which the further developments should be expected; (2) examining the problems involved in providing for set precision of schematic solutions under manufacturing conditions; (3) methods of overall planning of the manufacturing processes; and (4) organizational and technical measures for securing reliability in the manufacture of electronic computers. P.V.E.

N64-31314 Joint Publications Research Service, Washington, D.C.
ELECTRON BEAM MELTING
13 Oct. 1964 11 p refs Transl. into ENGLISH from Automaticheskaya Svarka (Kiev), no. 7, Jul. 1964
(JPRS-26891; TT-64-51148) OTS: $1.00

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1. VAPORIZATION OF METAL DURING MELTING WITH AN ELECTRON BEAM V. I. Lecomskiy and A. L. Tikhonovskiy p 1–6 refs
2. PRODUCING AN ELECTRON BEAM FROM A HOLLOW COLD CATHODE V. A. Zrazhevskiy p 7–8

N64-31328 Dow Chemical Co., Denver, Colo. Rocky Flats Div.
DEUTERIDED LITHIUM WIRE
J. L. Guyton and K. Terada 7 Oct. 1964 11 p
(Contract AT(29-1)-1106)
(RFP-428) OTS: $0.50

Lithium deuteride-coated lithium wire was successfully fabricated by extruding lithium wire and reacting it with deuterium at temperatures between 80° and 450° C. By controlling the reaction time and temperature, it is possible to produce a wire with a predetermined coating thickness. Because the resulting coated wire is extremely brittle, making it difficult to handle and subject to oxidation, handling in an inert atmosphere is desirable. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-30250 Aeronautical Research Labs., Melbourne (Australia)
A PRELIMINARY ASSESSMENT OF THE COMPARATIVE RESISTANCE OF CHROMIUM AND NICKEL BASED GAS TURBINE BLADE ALLOYS TO CORROSIVE ATTACK BY VANADIUM
O. Wilson Dec. 1963 17 p Sponsored by Dept. of Natl. Develop.
(ARL/ME-247)

A comparison has been made in static cascade tests between locally produced chromium-based turbine blade alloys and blades of Nimonic-type materials, when exposed to exhaust gases containing sulphur, vanadium, and sodium contaminants. Preliminary results indicate that the chromium alloy possesses superior resistance to surface attack and intergranular penetration. Author

N64-30398 Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center

EFFECT OF IMPURITY LEVELS OF ZIRCALOY 2 MICROSTRUCTURE, MECHANICAL PROPERTIES, AND CORROSION RATES

H. Kato, D. J. Stoops, and M. D. Carver 1964 24 p
(BM-RI-6536)

The effects of impurity elements silicon, aluminum, copper, nitrogen, and manganese, at 50 to 300 ppm, on properties of the zirconium alloy Zircaloy 2 were investigated. Variations in microstructure, mechanical properties, and corrosion behavior in some inorganic acid and salt solutions were observed with variations in level of impurity element. Corrodents were solutions of sulfuric acid, phosphoric acid, copper chloride, and iron chloride. Silicon was found to modify annealed microstructures by spheroidizing and by the dispersion of second-phase material throughout grains. Silicon or manganese improved ultimate and yield strength of the alloy without loss in ductility. All five elements affected corrosion rates of the alloy, the effect being generally different for each element. Author

N64-30438 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)

MATERIALS

In its Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 35 p refs (See N64-30427 22-24) OTS: $6.00

Investigations into materials problems, under the operating conditions of the MPD loop, undertaken in an effort to understand ultra-high-temperature loop technology are discussed. The results of tests of various components are presented. Included are results of examinations of the following: (1) a temporary tantalum transfer duct; (2) tantalum test strips; (3) tantalum thermocouple sheaths; (4) embrittled tantalum bellows; (5) black coatings on alumina-duct components; (6) tantalum pressure-pipe welds; and (7) generator side-wall sections after service. P.V.E.

N64-30454* Mellon Inst., Pittsburgh, Pa.

SYNTHETIC METALLIC SPHERULES IN A PHILIPPINE TEKTITE

Arch M. Reid, Frederick R. Park, and Alvin J. Cohen (Pittsburgh U.) Repr. from Geochim. Cosmochim. Acta, v. 28, 1964 p 1009–1010 refs
(Grant NsG-57)

Metallic spherules have been synthesized by melting a Philippine tektite under reducing conditions and then quenching to a glass. The spherules are smaller than those that occur naturally in philippinites and are metallic iron with no detectable nickel, sulphur, or phosphorus. Author

N64-30475 Carnegie Inst. of Tech., Pittsburgh, Pa. Metals Research Lab.

[FATIGUE OF METALS] Progress Report, 16 Apr.–15 Oct. 1963

15 Feb. 1964 18 p refs
(Contract AF 33(616)-6418)
(PR-14; AD-602875)

The migrational kinetics of point defect and point defect-impurity complexes in iron and iron–carbon alloys were investigated. Effort has been made in getting apparatus and procedures that will give accurate and precise measurements of resistivity at constant temperature after known thermal and mechanical histories. Several experiments with simple thermal histories have been performed and are detailed. Author

N64-30573 Naval Research Lab., Washington, D.C. Metallurgy Div.

METALLURGICAL CHARACTERISTICS OF HIGH STRENGTH STRUCTURAL MATERIALS Fourth Quarterly Report, Feb.–Apr. 1964

R. J. Goode, R. W. Huber, D. G. Howe, R. W. Judy, T. W. Crooker et al Jun. 1964 60 p refs
(NRL-6137; AD-602412) OTS: $3.00

A progress report covering research studies in high-strength hull structural materials is presented. These studies included the development of preliminary relationships of flaw size and stress for fracture of quenched and tempered steels, maraging steels, and titanium. Preliminary information was developed on the relationships of fracture toughness tests for aluminum. Heat-treatment studies for titanium alloys indicated improvements in fracture toughness for specific levels of yield strength. Evidence that low-cycle fatigue crack growth is a strain-controlled process is presented for specially rolled and heat-treated HY-80 steels. Author

N64-30576 MSA Research Corp., Callery, Pa.

THERMOPHYSICAL AND TRANSPORT PROPERTIES OF LIQUID METALS Second Quarterly Progress Report, Apr.–Jun. 1964

F. Tepper, J. Zelenak, F. Roehlich, and V. May 15 Jul. 1964 21 p refs
(Contract AF 33(615)-1273)
(MSAR-64-78; AD-443950)

The density of liquid potassium has been determined over the range 470° to 2,000° F and is presented. Also, the electrical resistivity and thermal conductivity of liquid sodium are given. Cesium surface tension data to 1,400° F are included. The results of eight experimental determinations of the PVT characteristics of cesium vapor are listed. Pressure–temperature measurements in general agree with vapor pressure data obtained earlier. The vapor viscometer calibration is partially completed, and reasonable agreement between measured values of argon viscosity and literature values is being realized. The vapor pressure of eutectic NaK has been measured from 1,236.1° to 1,934.5° F with values of 237.4- and 5,403.0-mm Hg at these respective temperatures. Author

N64-30598 Battelle Memorial Inst., Columbus, Ohio

SURVEY OF CURRENT KNOWLEDGE OF METAL DEFORMATION PROCESSING AND DEFORMATION CHARACTERISTICS OF BERYLLIUM, REFRACTORY METALS, SUPERALLOYS, AND HIGH-STRENGTH STEELS, AND OTHER DIFFICULT-TO-FORM METALS Final Report

Francis W. Boulger 14 Aug. 1964 307 p refs
(Contract N600(19)-60240)
(AD-446229)

In order to be useful for engineering students and production engineers the topics are treated in two ways. Generalized discussions of common processes point out why specific variables must be modified in order to deform certain types of metals satisfactorily. When practical, data on the more difficult-to-form metals are used to illustrate the principles, limitations, and effects of the processes. Research in metalworking advances the understanding of processing operations and reduces the gap between theoretical and practical experience. Therefore, some of the sections cover particular reactions and properties that are affected by deformation history. Author

N64-30599 Frankford Arsenal, Philadelphia, Pa.
WELDING 214, 356, AND ALMAG 35 CAST ALUMINUM ALLOYS TO 5456 WROUGHT ALUMINUM ALLOY
M. S. Orysh and I. G. Betz Jul. 1964 21 p refs
(R-1726; AD-444513)

Cast 214, 356-T6, and Almag 35 aluminum plate (3/8 in. thick) were welded to wrought 5456 aluminum alloy plate (3/8 in. thick), using the gas tungsten-arc process. Commercial filler metals 4043, 5183, and 5556 were used. Two beads were deposited on both sides of a double vee joint. It was determined by radiography that the weldments were of excellent quality. No defects were noted, except for slight tungsten inclusions in one weld. All tensile test specimens, with the reinforcements removed, failed in the cast member. The weldments containing Almag 35 casting yielded the highest tensile properties. Although the joint efficiencies of the 356-T6/5456 weldments were low, the as-welded properties of this combination were approximately equal to the properties of the 214/5456 weldments. The choice of filler metals had little influence on the weldment properties. Author

N64-30607* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
INVESTIGATION OF ROOM-TEMPERATURE SLIP IN ZONE-MELTED TUNGSTEN SINGLE CRYSTALS
R. G. Garlick and H. B. Probst Repr. from Trans. of the Metallurgical Soc. of AIME, v. 230, Aug. 1964 p 1120–1125 refs
(NASA-RP-312)

Tungsten single-crystal specimens of various orientations were deformed in tension at room temperature. Slip traces indicated both (112) (111) and (110) (111) slip; however, about 10% plastic deformation was required before these traces could be seen. Resolved shear–stress considerations indicated that at least some of the particular systems observed were not those on which slip initiated, but were secondary systems. This is highly probable, considering the high plastic strains involved. Analysis of the stress data with respect to possible slip systems indicated that slip must have been initiated at stresses below the proportional limit stresses measured. Author

N64-30631 Atomic Energy of Canada Ltd., Chalk River, Ontario Nuclear Labs.
IRRADIATION EXPERIENCE WITH ZIRCALOY-2
W. R. Thomas, S. B. Dalgaard, W. Evans, V. Fidleris, G. W. Parry et al [1964] 16 p refs Presented to the 3rd U.N. Intern. Conf. on the Peaceful Uses of Atomic Energy, Geneva, 31 Aug.–9 Sep. 1964
(AECL-2021) Available from Sci. Doc. Distr. Office, Chalk River: $0.50

One of the pressure tubes from the NPD reactor was inspected after 1 year of in-service operation. The inspection consisted of dimensional gaging with especially designed instruments, and of visual examination with a boroscope. Fuel irradiations in the test loops of NRX and NRU have been carried to exposures up to 10,000 Mwd/ton. Hydrogen concentrations in the fuel cladding were determined for several tests. Zircaloy-2 tensile and impact specimens, with properties estimated to be equivalent to that of material with about 12% cold work and containing 0, 20, 100, and 250-ppm hydrogen, were irradiated to 10^{21} n/cm^2 (E > 500 ev) at a calculated temperature of 270° to 280° C. The specimens and controls were then tested at room temperature, 300° C, and 400° C. Measurements have been made on an instrumented mockup capsule in order to study in-reactor creep. In studying the effects of hydrides, Zircaloy-2 wire specimens containing 100-ppm H were bent to produce known outer-fiber strains of up to 20%, were annealed within the range 325° to 800° C, and were then cooled at about 1° C/min to reprecipitate hydrides. For study of the phenomenon of corrosion and hydriding of Zircaloy-2 in pressurized water and steam, coupons of Zircaloy-2 were exposed to different coolants in the Chalk River loops. P.V.E.

N64-30638 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
ANALYSIS OF THE FATIGUE PHENOMENON IN ALUMINUM ALLOYS
J. Schijve Apr. 1964 65 p refs
(NLR-TR-M.2122)

The fatigue phenomenon in aluminum alloys is analyzed on the basis of empirical evidence derived from the literature and results of some recent tests. Main emphasis is on the aluminum copper alloys (2024-type). An attempt was made to develop a dislocation model that could explain crack nucleation and propagation. The following questions were studied: (1) Does crack propagation occur along crystal planes? (2) Does it occur in all load cycles? (3) Is high-level fatigue fundamentally different from low-level fatigue? (4) How does cyclic strain-hardening occur? (5) What are the variables controlling the crack propagation? The discussion includes simple dislocation concepts, interactions of slip and precipitated zones, and calculations on shear stress distributions around cracks. Author

N64-30670 Joint Publications Research Service, Washington, D.C.
PHASE TRANSFORMATIONS IN THE IRON-VANADIUM SYSTEM
M. I. Zakharova et al 10 Sep. 1964 8 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Met. i Toplivo (Moscow), no. 5, Sep.–Oct. 1959 p 135–138
(JPRS-26338; TT-64-41597) OTS: $1.00

An investigation of the structure and magnetic properties of Fe-V alloys is presented. It establishes that a second, high-temperature magnetic phase (β-phase) exists that has a Curie point at approximately 220° C and an fcc lattice. Author

N64-30678 Martin Co., Baltimore, Md. Rias Div.
EFFECT OF IMPURITIES ON THE RESISTIVITY RECOVERY SPECTRUM OF COLD WORKED CADMIUM
F. R. Stevenson and H. R. Peiffer Sep. 1963 16 p refs
(Contract Nonr-3707(00))
(TR-6; AD-419849)

Damask and Dienes have shown theoretically how the recovery of vacancies is affected by the presence of impurity atoms. They discovered that the magnitude of the activation energy of migrating vacancies in copper is altered and that only in the purest materials does the measured activation energy correspond to the true migration energy of the vacancy. This behavior arises because in the annealing process there is a rapid buildup of vacancy-impurity complexes from free vacancies and impurities and the observed recovery is characterized by an energy associated with the dissociation of the complexes as well as the usual motion energy of a vacancy with no impurities present. Recent work on cold-worked cadmium of two different impurity concentrations has shown that the vacancy recovery is indeed affected by the presence of impurities. The present investigation is an extension of this work to high-purity cadmium doped with known amounts of copper, lead, and magnesium. Author

N64-30692 Michigan U., Ann Arbor
ASSESSMENT OF THEORIES OF FLOW AND FRACTURE Technical Documentary Report, 1 Jan. 1962–28 Feb. 1964
R. M. Haythornthwaite and D. R. Jenkins Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 58 p refs
(Contract AF 33(657)-7531)
(ML-TDR-64-158; AD-603497) OTS: $3.00

Experimental initial yield, strain hardening, and fracture data for arc-cast unalloyed molybdenum tubular specimens are compared with simple theoretical models. The tubular specimens were subjected to various combinations of axial force and internal pressure at testing temperatures of 75° and 212° F. Initial yield data are in fairly good agreement with a maximum reduced stress yield criterion, which accounts for axially symmetric anisotropy. The theory of kinematic hardening gave good predictions of subsequent yield values during strain hardening for the 75° F data. For tests at 212° F, markedly poorer predictions of subsequent yield were given. A maximum normal stress theory of fracture was in fair agreement with experimental data. Data are also presented on the behavior of cantilever beams made of Zamak-3 zinc alloy. Author

N64-30705 Republic Aviation Corp., Farmingdale, N.Y. Engineering Structures Section
RESEARCH INVESTIGATION ON MECHANICAL PROPERTIES OF NICKEL AND COBALT BASE ALLOYS FOR INCLUSION IN MILITARY HANDBOOK-5 Progress Report, Dec. 8, 1962–Mar. 8, 1963
A. Greene 11 Mar. 1963 71 p
(Contract AF 33(657)-8924)
(ESRD-13-10; RAC-1256; AD-418639)

This report summarizes initial mechanical property test data obtained for L-605 alloy material for tension, compression, bearing, shear, stress rupture, creep, and fatigue at room and elevated temperatures, and for longitudinal and transverse directions. The data are submitted in tabular form with accompanying graphs where feasible. Author

N64-30787* Minnesota U., Minneapolis Heat Transfer Lab.
EFFECT OF SURFACE ROUGHNESS ON THE TOTAL HEMISPHERICAL AND SPECULAR REFLECTANCE OF METALLIC SURFACES
R. C. Birkebak, E. M. Sparrow, E. R. G. Eckert, and J. W. Ramsey Repr. from J. Heat Transfer, v. 86, May 1964 p 193–199 refs Presented at ASME-AIChE Heat Transfer Conf. and Exhibit, Boston, 11–14 Aug. 1963
(Grant NsG-137-61)
(ASME Paper-63-HT-6)

Measurements have been made of the hemispherical and specular reflectance of metallic surfaces of controlled roughness. The surfaces, which were ground nickel rectangles, were irradiated at various angles of incidence by a beam of blackbody radiation, the temperature of which was also varied. The instrumentation that was devised to perform the experiments is described. The measurements show that, beyond a certain surface roughness, the hemispherical reflectance is virtually independent of further increases in roughness. On the other hand, the specular reflectance decreases steadily with increasing roughness. Additionally, the hemispherical reflectance is found to be quite insensitive to the angle of incidence, while the specular reflectance increases with angle of incidence for the rougher surfaces. Author

N64-30798 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NONFERROUS METALLURGY
29 Jun. 1964 246 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Tsvet. Met. (Dzaudzhikau), no. 1, 1963 p 1–181
(FTD-MT-64-12; AD-603401) OTS: $6.00

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30. CONFERENCE ON EXCHANGE OF EXPERIENCE IN INTENSIFICATION OF THE OPERATION, MODERNIZATION AND IMPROVEMENT OF THE DESIGN OF FLOTATION MACHINES p 237–240

N64-30813 Rocketdyne, Canoga Park, Calif. Research Dept.
APPLICATION OF THIN-FILM ELECTRON MICROSCOPY TO REFRACTORY METAL PROCESSING Quarterly Progress Report, 11 Mar.–11 Jun. 1964
R. P. Jewett 11 Jul. 1964 20 p refs
(Contract NOw-64-0299-D)
(R-5776-1; AD-603127)

The results of deforming commercially pure tantalum by cold rolling are comparable to the results obtained with tantalum deformed in tension. Preliminary results of cold rolling tantalum show that dislocation arrays do not increase proportionally with the degree of cold work. On the other hand, cell structure becomes more fully defined with increasing deformation. As in tension, it was found that the grain boundaries can act either as sinks or sources for dislocation, depending upon the amount of deformation. Author

N64-30818 Brush Beryllium Co., Cleveland, Ohio
DEVELOPMENT OF VERY HIGH STRENGTH BERYLLIUM WIRE Bimonthly Report No. 3, Apr. 6–Jun. 6, 1964
E. A. Murphy and R. G. O'Rourke 6 Jun. 1964 30 p refs
(Contract NOw-64-0162-c)
(TR-360-243; AD-603066) OTS: $2.00

The results of work directed toward development of a process to produce high-strength beryllium fine wire are described. Material chemistry for the 5% copper–beryllium and 0.48% iron–beryllium alloys is listed. The beryllium–iron alloy was found not adaptable for the warm-drawing technique. Drawing capability of the fine-grained materials was found to decrease with decreased grain size and increased oxide content. Author

N64-30821 Bureau of Mines, Albany, Ore. Metallurgy Research Center
ROLLED MOLYBDENUM SINGLE CRYSTALS. DEFORMATION TEXTURES, RECRYSTALLIZATION, AND TRANSITION TEMPERATURE
R. Blickensderfer, R. Siemens, G. Asai, and H. Kato 1964 39 p refs
(BM-RI-6539)

Six large molybdenum single crystals obtained from an ingot melted by electron beam were oriented by X-ray diffraction and rolled on crystallographic planes of low indices in a known direction. During room-temperature rolling, cleavage occurred on {100} type planes. At 300° C the crystals were rolled to 95% reduction in thickness. Pole figures were used to correlate the deformation textures of the rolled crystals with the initial crystallographic orientation. The 1-hour recrystallization temperature of the crystal (211) [11$\bar{3}$] was 700° C, which is about 300° C lower than that of commercial polycrystalline molybdenum. The poles of the slip planes (as determined from gross slip lines at relatively low magnification) tended to lie within 20 to 60 degrees of the pole of the rolling plane. The ductile–brittle bend transition temperature was dependent upon the rolling orientation and the dislocation density. Author

N64-30826 David Taylor Model Basin, Washington, D.C. Structural Mechanics Lab.
FACTORS INFLUENCING THE FATIGUE LIFE OF AN HY-80 COMPOSITION STEEL FULLY QUENCHED AND TEMPERED TO VARIOUS STRENGTH LEVELS
A. R. Willner and M. L. Salive Jun. 1964 33 p
(DTMB-1807; AD-602075)

This report evaluates the effects of strength level, Charpy V-notch energy, prestraining, prestraining and stress relieving, and austenitizing temperature on the fatigue life of a fully quenched HY-80 steel composition. The fatigue data developed herein indicate that the designer would have to be cautious when going to higher strength steel when using a safety factor considered satisfactory for lower strength steels; i.e., if higher strength steels are to be used, larger safety factors are necessary to obtain a comparable fatigue life. The limited data presented on experimental HY-150 steels indicate that caution will have to be exercised in evaluating large-specimen fatigue data. Author

N64-30864 Union Carbide Corp., Kokomo, Ind. Stellite Div.
PROCESS IMPROVEMENT OF COLUMBIUM (Cb-752) ALLOY, PHASE II Interim Engineering Progress Report, 1 Dec. 1963–31 Mar. 1964
J. G. Bewley and M. Schussler Wright-Patterson AFB, Ohio, Mfg. Technol. Div. [1964] 80 p ref
(Contract AF 33(657)-11210)
(AD-600403) OTS: $4.00

Approximately 800 pounds of Cb-752 alloy (columbium–10% tungsten–2.5% zirconium) 1/4-in.-thick sheet bar were processed to 0.060-in.-thick, 30-in.-wide sheets. About 200 pounds of sheet in 0.060-, 0.030-, 0.018-, and 0.012-in. gages were produced from this material. One large sheet was utilized to study the effects on alloy properties of a duplex annealing process. A total of 48 different processing cycles were investigated. A solution treatment at 2,800° F, followed by 40% reduction by cold rolling, with a final anneal at 2,400° F appears to produce the best combination of strength and ductility properties in Cb-752 alloy. Author

N64-30876 Materials Research Lab., Inc., Richton Park, Ill.
THE USE OF STRAIN SOFTENING TO IMPROVE THE PROPERTIES OF REFRACTORY METALS Quarterly Progress Report, 1 Mar.–31 May 1964
E. J. Ripling and S. Zager [1964] 13 p refs
(Contract NOw-64-0247-c)
(QPR-2; AD-603067)

Modifications in the roller flexer make it possible to exert satisfactory control of the amount of surface and thickness strain, as well as their ratio, during flexing. Work has been continuing to determine the flexing procedure that will result in the maximum lowering of transition temperature. Unfortunately, the scatter in NDT for the most recently obtained heat of Mo-0.5 Ti alloy is so broad (approximately 80° F) it has been difficult to evaluate property changes. In spite of the excessive scatter, a general behavior pattern appears to be developing: Flexing does not cause a uniform lowering of the transition temperature as might be expected, for example, with a continuous decrease in interstitial content. Instead, the bend-angle vs testing temperature curve is similar to the as-received one down to the vicinity of the NDT temperature (possibly with a lower shelf height). At still lower temperatures a ductility recovery occurs causing a hump or double transition. Author

N64-30882 General Electric Co., Schenectady, N.Y. Research Lab.
AN INVESTIGATION OF STRUCTURAL DAMAGE IN METAL-FORMING PROCESSES Final Report, 18 Jun. 1963–18 May 1964
H. C. Rogers, R. C. Leech, and L. F. Coffin, Jr. Jul. 1964 54 p refs
(Contract NOw 63-0671-c)
(AD-603404) OTS: $3.00

A study of structural damage in the sheet-drawing of OFHC copper, tough-pitch copper, and aluminum alloy 6061-T6 was undertaken in an attempt to investigate the role of the stress state occurring during deformation to the concomitant changes in the microstructure that would influence the resultant mechanical properties. Because of its completeness, the Hill–Tupper slip-line field solution for sheet-drawing was employed, and experimental drawing experiments were conducted matching as closely as possible the assumptions of the theory regarding plane strain, constancy of yield stress, and die geometry. Structural damage, as assessed by microscopic examination, and density changes on drawn sheet revealed that central plane void formation developed in those cases where high hydrostatic tensions were produced in the deformation zone under conditions of repated drawing. Void formation was pronounced in the case of the tough-pitch copper and less evident in the cleaner OFHC copper. Author

N64-30888 Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
VAPOR-PLATING OF TUNGSTEN FOR ROCKET APPLICATIONS
Vernon A. Nieberlein 1 Jul. 1964 39 p refs
(PR-TR-64-6; AD-603373)

Vapor plating of tungsten coatings by hydrogen reduction of tungsten hexafluoride has been adapted to flight model missile hardware. Very thin coatings have performed well in plasma and rocket engine tests. Tendency of the deposit to crack has been investigated in terms of the parameters of deposition temperature, gas velocity, and H_2/WF_6 ratio. Author

N64-30902 IIT Research Inst., Chicago, Ill.
IMPROVED PRODUCTION OF POWDER METALLURGY ITEMS Interim Technical Documentary Progress Report, 1 Jan.–31 Mar. 1964
K. Farrell and N. M. Parikh Wright-Patterson AFB, Ohio, ASD [1964] 13 p
(Contract AF 33(657)-9140)
(ASD-TDR-7-911(VII); AD-601482)

Attempts to consolidate large superalloy powder billets by cold pressing and sintering are described. The TZM billets made by powder metallurgy techniques are ready for extrusion. The three superalloy powder billets have been cold pressed and are being hot pressed to density. The extrusion of all these billets to T-sections will be completed shortly. Author

N64-30905 Atomic Energy of Canada Ltd., Chalk River, Ontario.
THE EFFECT OF COOLING RATE ON THE HARDNESS OF ZIRCONIUM-NIOBIUM ALLOYS
B. A. Cheadle Jun. 1964 24 p refs
(CRRM-1200; AECL-2039)

The effect of cooling rate and niobium content on the hardness of Zr-Nb alloys was investigated using a Jominy end quench test. Specimens cooled in this test were subjected to a wide range of cooling rates from a water quench (1,000° C/sec) to an air cool. The composition of the alloys varied from Zr-2.3% Nb to Zr-5.3% Nb. The maximum as-quenched hardness of alloys containing more than 2.5% Nb was not produced by a water quench but by a slower cooling rate of 22° C/sec. After aging, the water-quenched material hardened appreciably to the highest value observed for the alloy, but the hardness of the material cooled at 22° C/sec changed very little. The maximum as-quenched hardness of alloys containing less than 2.5% Nb was produced by the fastest cooling rate used (water quench). The observations that were made on the alloys using metallographic, X-ray diffraction, and electron microscopy techniques are reported. Author

N64-30906 Atomic Energy of Canada Ltd., Chalk River, Ontario
THE EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF HYDRIDED ZIRCONIUM ALLOYS
A. Sawatzky Jun. 1964 17 p refs
(AECL-1986)

This paper describes the effects of neutron irradiation on the mechanical properties of zirconium–2.5 wt % niobium and cold-worked Zircaloy-2 having hydrogen contents from zero to 300 ppm. Specimens were irradiated at 280° C to an integrated neutron flux of 1.0×10^{21} n/cm^2 with energies >500 eV. The tensile strength of both alloys increased with irradiation. However, they were little affected by hydrogen concentrations over the range investigated. The impact strength was decreased by irradiation and, to a lesser extent, by hydrogen. Author

N64-30915 California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science
TEMPERATURE EFFECTS IN CAVITATION DAMAGE
Robert E. Devine and Milton S. Plesset Apr. 1964 26 p refs
(Contract Nonr-220(28))
(Rept.-85-27; AD-438223)

Cavitation damage is studied for several materials over a range of temperatures in the cavitating liquid from 0° to 90° C. The cavitating liquids used were distilled water, distilled water

buffered to pH8, and a 3% solution of NaCl in distilled water. The cavitation damage was produced by continuous oscillation of the test specimens with a magnetostrictive transducer, so that long-term chemical effects tended to be suppressed. It is found that a maximum in the damage rate occurs at temperatures in the range of 40° to 50° C, and that the maximum is independent of the material. The damage in this laboratory procedure appears to correlate directly with the change in vapor pressure of the liquid and inversely with the concentration of dissolved air. Author

N64-30923 Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.
RESEARCH ON THE BINARY IRON-NICKEL ALLOYS WITH 20 TO 25 PERCENT NICKEL Technical Documentary Report, 1 Mar. 1961–30 Sep. 1962
E. P. Gilewicz, W. A. Fragetta, V. Mehra, and R. Krohn Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 500 p refs
(Contract AF 33(616)-8018)
(ASD-TDR-62-996; AD-605283)

The physical metallurgy, mechanical properties, and weld properties of the binary iron-nickel-base alloys designated as maraging steels are presented in this report. The primary data obtained during the program consisted of sheet and bar tensile properties as a function of various heat treatments and mill processing variables. Also determined were the fracture toughness parameters corresponding to strength levels produced by the various conditions mentioned above. Secondary data generated included elevated temperature tensile properties, billet and forging properties, room-temperature fatigue properties, and Charpy impact strengths at cryogenic temperatures. Author

N64-30929 Boeing Co., Seattle, Wash.
METAL-CERAMIC STRUCTURAL COMPOSITE MATERIALS Technical Documentary Report, Feb. 1961–Feb. 1962
J. W. Vogan and J. L. Trumbull Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 128p refs
(Contract AF 33(616)-7815)
(ML-TDR-64-583; AD-604685)

Thoria and magnesia bodies were developed for use in metal–ceramic composites. Good thermal shock resistance was imparted to these bodies through control of particle-size distribution. Magnesia was sintered at 2,200° F and thoria at 2,800° F. Plasma and oxyacetylene torch tests developed to evaluate these materials and similar zirconia composites showed that magnesia and zirconia can be used to 4,600° F and thoria to 5,400° F. The order of decreasing emittances for the pure bodies is as follows: (1) zirconia, (2) magnesia, and (3) thoria. The addition of chrome oxide to the magnesia body increased its apparent emittance to that of zirconia—0.8 at 4,000° F. Magnesia produced lower weight composites than either of the other ceramics. Zirconia and magnesia show a steady decrease in strength to 3,200° F, at which point an increase occurs. Platinum and Inconel honeycomb were selected for use as a metal reinforcement for these bodies to produce material systems suitable for use in high heat-flux applications, such as the nose cap of a glide reentry vehicle. Author

N64-30988 Allegheny Ludlum Steel Corp., Brackenridge, Pa. Research Center
EXTRUDING AND DRAWING MOLYBDENUM TO COMPLEX THIN H-SECTION Fourth Interim Technical Engineering Report, 1 May–31 Jul. 1964
P. A. Santoli Wright-Patterson AFB, Ohio, Res. and Technol. Div., Aug. 1964 81 p refs
(Contract AF 33(657)-11203)
(RTD-TR-8-112; AD-605614)

Sixteen H-shaped extrusions (14 TZM and 2 stainless) were made with new support tooling. No failure or distortion occurred in the tooling, regardless of liner pressure up to 237,000 psi. Reasonable quality and dimensional runout were found in TZM extrusions at a reduction ratio of 43:1 from 3,200° F billet temperature with the use of flame-sprayed zirconia dies. Similar extrusions from 3,350° F were poor. The use of pressed and sintered solid zirconia nibs was demonstrated successfully for the extrusion of H shapes. Dimensional runout for both stainless and TZM was remarkably good, and liner pressures were lower than those required for extrusions with segmented, coated dies. Author

N64-30997* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
BEND TRANSITION TEMPERATURE OF ARC-CAST MOLYBDENUM AND MOLYBDENUM — 0.5-PERCENT-TITANIUM SHEET IN WORKED, RECRYSTALLIZED, AND WELDED CONDITIONS
John H. Sinclair Washington, NASA, Oct. 1964 19 p refs
(NASA-TN-D-1869) OTS: $0.50

Both materials, when annealed at 2,000° or 2,400° F to give recrystallized structures, gave fine grain structures (about 3,500 grains/mm^2). These materials had ductile-to-brittle bend transition temperatures (90° bend over a 4 T radius punch descending at a rate of 1/2 in./min) of 0° to 40° F as compared with -110° to 5° F for the materials in the fibrous, as-worked condition. When the specimens were arc welded in a helium atmosphere with a nonconsumable tungsten electrode, the transition temperatures of both materials varied from 140° to 350° F. The grain size in the fusion zone of the welded specimens was large (2 to 5 grains across a 40-mil (1.02-mm) specimen). Specimens annealed in a vacuum at 3,500° F to yield grain sizes equivalent to those found in the fusion zones of welds had transition temperatures of 350° F and above. Author

N64-31001* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
PROGRESS IN SUPERALLOYS
John C. Freche Washington, NASA, Oct. 1964 15 p refs
(NASA-TN-D-2495) OTS: $0.50

Advanced temperature nickel- and cobalt-base alloys are under development. The strongest nickel-base alloys developed compare favorably in high-temperature strength with the strongest cast commercial nickel-base alloys and have some workability. The cobalt-base alloys compare well in high-temperature strength with the strongest cast commercial cobalt-base alloys and have good rollability characteristics. The cobalt-base alloys are unique in that they are strengthened primarily by low-volatility materials, such as the refractory metals. Because of this, they are inherently more resistant to evaporation in a vacuum environment than conventional cobalt-base superalloys that contain large amounts of chromium. Author

N64-31004* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
AN EXPLANATION OF MICROSTRUCTURES IN THE TANTALUM-CARBON SYSTEM
G. Santoro and H. B. Probst Repr. from Advances in X-ray Analysis, v. 7 Proc. of the 12th Ann. Conf. on Applications of X-ray Analysis, 7–9 Aug. 1963 p 126–135 refs
(NASA-RP-319)

Compositions in the tantalum–carbon system were prepared by carburizing high-purity tantalum wires. The microstructures so produced exhibit regions of a characteristic striated structure, identical to those observed by earlier investigators. There are disparities in the literature as to the origin of such structures in the tantalum–carbon system. They have been variously described as twins, striated structure, precipitate, and structure of unknown origin. This paper presents conclusive evidence that the structures in question are the result of precipitation on cooling. In addition, a coherent precipitation model is applied in which it is shown that the lattice relationship $\{0001\}_{Ta_2C} \| \{111\}_{TaC}$ can exist with less than 0.5% misfit. Author

N64-31027 Hanford Atomic Products Operation, Richland, Wash.
METALLURGY RESEARCH OPERATION Quarterly Progress Report, Apr.–Jun. 1964
J. J. Laidler et al 15 Jul. 1964 155 p refs
(Contract AT(45-1)-1350)
(HW-82651) OTS: $2.75

Results of the following studies are reported: (1) neutron damage to metals; (2) swelling of irradiated fissionable material; (3) plutonium physical metallurgy; (4) reactor-metals research, including alloy selection, in-reactor measurements of mechanical properties, irradiation damage to nickel-base alloys, and damage mechanisms; (5) environmental effects on reactor materials; (6) reactor gas loop corrosion studies; (7) reactor-materials development; (8) advanced reactor-concept studies; (9) reactor corrosion and hydriding; and (10) engineering of reactor pressure tubes. M.P.G.

N64-31029 IIT Research Inst., Chicago, Ill. Technology Center
FIBER-REINFORCED METALS AND ALLOYS Bimonthly Report, Mar. 8–May 8, 1964
N. M. Parikh 8 Jun. 1964 18 p
(Contract NOw-64-0066-c)
(IITRI-B6020-3; AD-602157) OTS: $1.00

The investigation, conducted on composites of silver with very low and very high steel-fiber concentrations, indicates the following tentative conclusions. Maximum reinforcement of silver by steel fibers is obtained at less than 50% concentration of the fibers, and varies with the fiber diameter. Strengthening depends on the fiber diameter and strength. The range of composites exhibits a ductile-to-brittle transition. Photomicrographically revealed fractures in composites with low fiber concentration are ductile, and fractures in composites with high fiber concentration are brittle. D.E.W.

N64-31034 Joint Publications Research Service, Washington, D.C.
HOT STAMPING OF TITANIUM ALLOY BLANKS
L. A. Nikol'skiy 5 Oct. 1964 169 p refs Transl. into ENGLISH of Chapters 3, 4, 7, and 8 from the Monograph "Goryachaya Shtampovka Zagotovok iz Titanovykh Splavov" Moscow, 1964 p 20–98, 137–200, 225–226
(JPRS-26689; TT-64-41946) OTS: $5.00

The chapters presented cover the following: General Characteristics of Engineering Properties, Thermodynamic Parameters of Hot Pressure Working, Forging and Stamping, and Heat Treatment of Semifinished Products (rods, forgings, stamped blanks and sheets). Author

N64-31041 Rock Island Arsenal Lab., Ill.
YTTRIUM AS A NODULIZER FOR CAST IRON
W. C. Wurtz 4 Mar. 1964 16 p ref
(Rept.-64-730; AD-602457) OTS: $1.00

Yttrium metal in varying amounts was added to experimental laboratory heats of cast iron to study operating procedures and related problems involved in its use as a nodulizer. Approximately 0.20% to 0.25% yttrium, added to the charge, produced the most satisfactory microstructure and mechanical properties. Nodular iron made with yttrium has mechanical properties similar to nodular iron made with magnesium. However, the present price of yttrium makes it economically unsound for use in foundry production castings. Materials such as silicon and nickel alloyed with yttrium did not improve the nodulizing efficiency. Superheating the molten bath before adding the yttrium improved the mechanical properties. Author

N64-31060 Los Alamos Scientific Lab., N. Mex.
A CRITICAL REVIEW OF REFRACTORIES
Edmund K. Storms 13 Aug. 1964 254 p refs Supersedes LAMS-2674, Pt. 1 and LAMS-2674, Pt. 2; see N62-17458
(Contract W-7405-ENG-36)
(LA-2942) OTS: $3.50

The literature concerning the Group-4a, -5a, and -6a carbides and nitrides, and the carbides and nitrides of Th, U, and Pu has been reviewed critically. The following properties have been discussed: preparation, phase relationship, lattice parameter and structure, appearance, chemical stability, hardness, resistivity, superconductivity, thermodynamic properties, and vaporization. When possible, each property has been considered in light of the wide homogeneity range exhibited by these compounds. Particular attention has been paid to methods by which the materials can be made oxygen and nitrogen free. Author

N64-31095 Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
ELECTRON BEAM BRAZING OF BERYLLIUM
E. F. Deesing 27 Jul. 1964 4 p
(NAEC-AML-1997; AD-603192) OTS: $1.00

Eleven filler metals were used in bead tests under vacuum, using a defocused electron beam—high purity Ag, Ag-Cu eutectic alloy, Ag-braze alloy, Ag-sterling alloy, Ag-0.3% Li alloy, Ag-1.0% Be alloy, Ag-5% Al alloy, high-purity Al, Al-12% Si alloy, Zn-Al-Cu alloy, and commercially pure Zn. Brazing of beryllium was attempted with those filler metals that appeared to melt and to wet titanium alloy. However, these filler metals exhibited very poor wettability on chemically cleaned beryllium surfaces. The BeO content of the sintered beryllium apparently inhibited the wettability and flow of the filler metals. The highly reactive beryllium surface also contributed to the poor wettability by combining with extraneous elements present in the filler metal. It was also concluded that electron-beam heating was not practical for the brazing process because of the intense localized heating effect produced even at low-energy outputs. Other means of heating in vacuum would be more practical. R.L.K.

N64-31162 Northrop Corp., Hawthorne, Calif. Norair Div.
DEVELOPMENT OF IMPROVED METHODS, PROCESSES, AND TECHNIQUES FOR PRODUCING STEEL EXTRUSIONS Interim Engineering Report No. 17, 1 Jul.–30 Sep. 1963

L. M. Christensen Wright-Patterson AFB, Ohio, ASD, Sep. 1963 27 p
(Contract AF 33(600)-36713)
(NOR-63-170; AD-421870)

The detail planning is given for the initial extruding effort and the experimental warm drawing of an advanced airframe structure shape. Evaluation of previous work indicates that because of the lack of ductility in drawn sections of PH15-7 Mo resulting from cold working, it is advisable to straighten them when warm. Because of their high cooling rate, it is not practical to preheat and then stretch sections as thin as 0.04 in. Provisions should be made for heating during the stretching operation. When very thin sections are drawn, the shock connected with a manual draw bench hookup is excessive. A draw bench should be used that has provisions for starting from zero chain speed. Selection of draw temperature according to hardness values shown after each draw pass is beneficial in reducing or eliminating further work hardening in subsequent drawing. R.L.K.

N64-31164 Syracuse U., N.Y. Metallurgical Research Labs.
CRACK INITIATION IN METALLIC MATERIALS Quarterly Progress Report No. 3
K. Schroder, P. Packman, and V. Weiss Aug. 1963 15 p
(Contract N600(19)-59514)
(MET-E-1040-6308Q3; AD-420570)

The theoretical analysis of hole and notch stress fields continued. It is shown how the maximum stress of an elliptical crack is orientation dependent. The experimental investigation on the effect of surface defects continued. Notched sheet specimens of Ti-2.5Al-16V, heat treated to an extremely brittle condition, have been tested in uniaxial tension. To study the effects of surface condition on the fracture strength of tungsten, bend tests (in three-point loading) were conducted on machined specimens from which various amounts of surface material had been removed by electropolishing. As-received material showed a marked improvement with increased surface removal, whereas recrystallized material showed a loss in strength for surface removal up to 0.010 in. Author

N64-31180 Super-Temp Corp., Santa Fe Springs, Calif.
A COMPARATIVE EVALUATION OF THE FORMABILITY OF TUNGSTEN PLATE AND SHEET BY SPINNING TECHNIQUES Quarterly Report, Jun. 18–Sep. 30, 1963
J. R. Armstrong, D. W. Bauer, and G. L. Oberley 14 Oct. 1963 21 p refs
(Contract NOw-63-0542-C)
(QR-1; AD-420511)

This program endeavors to establish the relationship between the fabrication history, physical properties, and spinning characteristics of tungsten sheet and plate. Author

N64-31193 Melpar, Inc., Falls Church, Va.
2,000° POWER WIRE FOR AEROSPACE ENVIRONMENT Quarterly Report, Jul. 5–Oct. 5, 1963
M. L. Gimpl, E. E. Childs, and L. K. Eliason [1963] 22 p
(Contract AF 33(657)-11046)
(QR-2; AD-419970)

The first completed power wire systems capable of functioning at 2,000° F have been fabricated. The wire consists of a rhodium conductor, MgO insulation, platinum sheathing, and metalized alumina end seals. Rhodium has been electron-beam-float refined. This processing lowers the interstitial content and allows cold working the rhodium up to a 75% reduction in area. Author

N64-31195 Brown U., Providence, R.I.
ENGINEERING AND CONTINUUM ASPECTS OF HIGH STRENGTH MATERIALS
D. C. Drucker Jun. 1964 59 p refs
(Contract AT(30-1)-2394)
(TR-7)

The distinction is drawn between special devices for which extremely strong but fully brittle materials are permissible, and large engineering structures and machines for which some ductility is essential. The basic similarity is traced between an engineering structure formed by joining structural elements together, and a metallurgical structure formed by sintering particles togegher, or a fiber or whisker and matrix composite, or a polycrystal or two-phase alloy with grain boundaries. Continuum mechanics in a very elementary form is applied on both the macroscale and microscale to explore the effect of residual stress and thermal stress, to study size effects in sintered WC-Co and the problem of optimum volumetric ratio of the components, and to examine the influence of grain size and grain boundaries on yield strength and on creep strength of polycrystals. Author

N64-31220* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NASA RESEARCH ON MATERIALS APPLICABLE TO SUPERSONIC TRANSPORTS
Herbert F. Hardrath and George J. Heimeral Washington, NASA, Oct. 1964 14 p refs
(NASA-TM-X-1013) OTS: $0.50

On the basis of studies on fatigue behavior, rate of fatigue crack propagation, residual static strength, and resistance to deterioration of properties due to prolonged exposure to temperature, no serious materials problems are anticipated. However, stress corrosion is found to be a potentially serious problem in titanium alloys in a hot salt environment and in stainless steels in an ambient environment. The Ti-8Al-1Mo-1V alloy is found to be generally superior to other contending materials in all respects studied except for salt stress corrosion in which respect it was poorer than all others. Author

N64-31258 Universal-Cyclops Steel Corp., Bridgeville, Pa. Refractomet Div.
THE STATE-OF-THE ART OF WELDING OF REFRACTORY METALS
D. J. Seman and F. D. Seaman Jun. 1963 113 p refs
(Contract NOw-63-0043-c)
(AD-421905)

This document includes a literature and industrial state-of-the-art survey of refractory metal welding. The report summarizes the number and types of facilities engaged in refractory metal welding, summarizes the nature of refractory metal welding, and projects the current methods and limitations in terms of future needs. Author

N64-31276 Denver Research Inst., Colo.
RESEARCH ON THE SAMARIUM-TYPE INTERMEDIATE PHASES OF INTRA-RARE-EARTH BINARY SYSTEMS
J. F. Nachman, C. E. Lundin, and G. P. Rauscher, Jr. Jan. 1963 36 p refs
(Contract Nonr-3661(02))
(TR-1; AD-296192)

The existence of a samarium-type phase in intra-rare-earth alloys, consisting of a light and a heavy rare earth, has been verified in the La-Gd, La-Y, Ce-Y, and Nd-Y systems. X-ray diffraction and metallographic techniques were employed to establish the composition limits of the single- and two-phase regions. Precise lattice parameters and X-ray densities for the alloys were calculated from data obtained with the Debye–Scherrer camera. A hardness survey of the intra-rare-earth alloys is also presented. Author

N64-31277 General American Transportation Corp., Miles, Ill. MRD Div.
MECHANICS OF PENETRATION, VOLUME II: SINGLE AND LAMINATED PLATES Final Technical Report
L. E. Fugelso 31 Dec. 1962 170 p refs
(Contract DA-19-129-OM-1542)
(MR-1127; AD-421590)

Ballistic resistance of thin metallic plates, both single plates and laminates, to projectile impact is investigated. Two mathematical models are formulated, each emphasizing a critical aspect of the deformational process. The first model considers failure by high tensile or shear stress in the transient stress wave that propagates across the plate, and the second model considers failure by sustained plastic shear flow. Engineering models of fracture and flow under high-speed impact are evaluated, using the continuum theory of dislocations. These models are used in the analysis of the modes of failure. Critical impact velocities for failure are calculated and characterized as a function of dynamic material properties. Author

N64-31289 California Inst. of Tech., Pasadena W. M. Keck Lab. of Engineering Materials
METASTABLE CLOSE-PACKED STRUCTURES IN SILVER-RICH BINARY ALLOYS WITH TIN, ANTIMONY AND SILICON
W. Klement, Jr. Apr. 1963 8 p refs
(Contracts AT(04-3)-221; Nonr-220(30))
(TR-14; AD-403779)

Discussed is an attempt to metastably extend the primary solid solubility limit in Ag-base binary alloys with Sn, Sb, and Si, by rapidly quenching these alloys from the melt. Lattice parameters obtained for the Ag-Sn and Ag-Sb alloys are discussed. For these alloys, the lattice parameters vary linearly with composition up to ~8.0 at .% Sb and ~13.0 at .% Sn, respectively. At equilibrium, Ag-Si and Ag-Ge systems are homologous; the primary solid solubility of silicon in silver is, however, apparently quite limited. It was not possible to obtain lattice spacings that were sufficiently critical to establish either the variation of lattice spacing with solute content or the limit of metastable solid solubility for Ag-Si alloys. P.V.E.

N64-31292 Frankford Arsenal, Philadelphia, Pa.
STRESS CORROSION TESTS OF SOME WROUGHT Mg-Li BASE ALLOYS
J. C. Kiszka Jul. 1964 19 p refs
(M65-1-1; AD-603551)

Seven experimental wrought Mg-Li base alloys (Mg-14Li with various additions of Al, Zn, Ag, and/or Si) were tested for stress corrosion susceptibility in humid air, following mechanical and thermal processing to approximate conditions in the heat-affected zone of a weld. Stress levels during exposure were uncertain because of creep effects. Rapid cooling from 700° F rendered susceptible those alloys containing aluminum, regardless of other alloy content. However, heating for 24 hours at 300° F following such rapid cooling restored their resistance to stress corrosion. Alloys strengthened by additions of zinc, silicon, and/or silver, but with aluminum excluded, did not fail in stress corrosion under the conditions of test used in this study. Author

N64-31321 Aluminum Co. of America, New Kensington, Pa.
MECHANICAL PROPERTIES OF STRESS-RELIEVED STRETCHED ALUMINUM ALLOYS Quarterly Report, Dec. 15, 1962–Mar. 15, 1963
D. J. Brownhill and G. W. Stickley 15 Mar. 1963 46 p refs
(Contract AF 33(657)-7837)
(QR-4; AD-421582)

The tensile, compressive, shear, and bearing properties have been determined for 101 samples in the —TX51 tempers and for 21 samples in the "heat-treated-by-user" tempers of 2014, 2024, 7075, 7079, and 7178 aluminum alloy plate. The plate ranged in thickness from 0.250 to 4.499 in. Various relations among the properties also have been computed. Author

N64-31332* National Aeronautics and Space Administration, Washington, D.C.
NICKEL ALLOYS
Aug. 1964 6 p Transl. into ENGLISH of French Intern. Patent No. 1160309(C 22 c), Granted to Birmingham Small Arms Co., Ltd.
(NASA-TT-F-9100) OTS: $1.00 fs; $0.50 mf

Nickel alloys having increased resistance to failure (due to the addition of certain amounts of aluminum, boron, tungsten, and molybdenum) are discussed. The alloys are capable of being ground and have high resistance to failure resulting from creep at high temperature (800° to 1100° C). P.V.E.

N64-31335* National Aeronautics and Space Administration, Washington, D.C.
PHASE COMPONENTS OF THE TANTALUM-CARBON SYSTEM [FAZOVYYE SOSTAVLYAYUSHCHIYE SISTEMY TANTAL-UGLEROD]
L. B. Dubrovskaya, G. P. Shveykin, and P. V. Gel'd Aug. 1964 9 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 17, no. 1, 1964 p 73–77
(NASA-TT-F-9068) OTS: $1.00 fs; $0.50 mf

Twenty-four tantalum carbide samples, containing from 1.35 to 7.50 percent by weight, were prepared for testing. To clarify the dependence of composition and properties of carbides on the method of their preparation, some of the samples were synthesized from peroxide and carbon black, and the large part from tantalum hydride and carbon black. Metallographic analysis of the homogenized preparations with a small carbon content was carried out in the usual manner. Chemical analyses of the preparations were made on tantalum, as well as on total and free carbon. The X-ray analysis was performed using unfiltered copper emission, and lattice parameters were determined. Density measurements were performed, and thermoelectromotive force measurements were carried out on tantalum carbides with respect to copper. Results and conclusions are reported. D.E.W.

N64-31337* National Aeronautics and Space Administration, Washington, D.C.
PREPARATION AND PROPERTIES OF HIGH-MELTING CARBIDE ALLOYS [POLUCHENIYE I SVOYSTVA NEKOTORYKH TUGOPLAVKIKH KARBIDNYKH SPLAVOV]

G. V. Samsonov and V. N. Paderno Aug. 1964 9 p refs Transl. into ENGLISH from Zh. Prikl. Khim. (Moscow), v. 36, 1963 p 2759–2762
(NASA-TT-F-9064) OTS: $1.00 fs; $0.50 mf

Discussed are conditions for obtaining solid solutions of carbides of zirconium, hafnium, niobium, and tantalum by reducing mixtures of the corresponding oxides of the corresponding metals with carbon, under various conditions. These conditions are those in a hydrogen atmosphere, under vacuum, and under conditions of simultaneous hot pressing of the reduction products. A method was developed for preparing mutual alloys, of isomorphous carbides of the transition metals of periodic groups IV and V, that consisted of the joint reduction of mixtures of oxides of the corresponding metals with carbon, under conditions of simultaneous hotpressing. Investigation of certain physical properties of the carbide alloys indicated that alloys representing homogeneous solid solutions display superior characteristics in comparison to the individual carbides, and can be used for the needs of high-temperature technology. P.V.E.

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-30461 Georgia U., Athens
INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION Progress Report
W. C. Sears 3 Sep. 1964 21 p refs
(Contract AT-(40-1)-2418)

The purpose of this project is to investigate the changes in molecular structure produced by high-energy radiation on different organic polymers and to determine the mechanisms of radiation-induced growth and decay of unsaturation and changes in polymer crystallinity, cross-linking, and scission. These structural changes are determined by measuring the infrared spectra of polymer films before and after irradiation. Irradiations of the polymers were made in vacuum with gamma rays from Co^{60} Author

N64-30497 Thiokol Chemical Corp., Trenton, N.J.
NITROSO RUBBER: RESEARCH, DEVELOPMENT, AND PRODUCTION Quarterly Report, 1 Sep.–30 Nov. 1963
Marvin M. Fein [1963] 37 p refs
(Contract DA-19-129-AMC-69(X))
(RD-343-03; RMD-8576-Q3; AD-439696) OTS: $3.60

Additional safety testing of the trifluoroacetyl nitrite indicates that the process developed for CF_3NO production can be operated without undue hazard. Successful purification of CF_3NO has been achieved through the use of water and 5% caustic scrubbers, followed by a cold (−80° to −100° C) molecular sieve column to remove the last trace of impurities. Approximately 30 g of pentafluoronitrosobenzene has been prepared. The CF_3NO/C_2F_4 copolymers were prepared with intrinsic viscosities of 0.70. Author

N64-30579 Columbian Carbon Co., Princeton, N.J. Technology and Planning Dept.
CARBON BLACK FOR ORGANIC DEPOLARIZER BATTERIES Third Quarterly Progress Report, 1 Jan.–31 Mar. 1964
M. T. Johnston and J. E. Smith [1964] 24 p
(Contract DA-36-039-AMC-03239(E))
(Rept.-3; AD-602699)

Carbon-black samples from twelve runs on the 10S furnace have been evaluated in A-size organic depolarizer primary cells. Service life to 0.9 v at continuous load of 16 2/3 ohms ranged from about 19 to 25 hours. Oil-feed rate and oxygen enrichment at two positions in the furnace were significant. The presence of a vanadium additive in the feed oil increased service life about 1-hr. Data are presented on physical and chemical characteristics of the blacks. High service life was significantly associated with high values of color, tinting strength, and iodine surface area. Author

N64-30686 Forest Products Lab., Madison, Wis.
METHODS FOR EVALUATING TENSILE AND COMPRESSIVE PROPERTIES OF PLASTIC LAMINATES REINFORCED WITH UNWOVEN GLASS FIBERS
Karl Romstad Aug. 1964 29 p refs
(Contract AF 33(657)-63-358; BuWeps Order 19-64-8004-WEPS)
(FPL-052; AD-603486) OTS: $2.00

Methods of obtaining strength and elastic properties of plastic laminates reinforced with unwoven glass fibers were evaluated using the criteria of the strength values obtained and the failure characteristics observed. Variables investigated were specimen configuration and the manner of supporting and loading the specimens. Results of this investigation indicate that satisfactory tensile failures can be obtained by reinforcing the shank portion of the tension specimen with 1/32-in. sheet aluminum. Variation of tensile specimen geometry was inconclusive, with at least partial failures always occurring in the shank portion. Difficulty was encountered in trying to obtain accurate compressive strength data on the composite material comprising these laminates. Some acceptable compression failures were obtained using a 5 1/8-in.-long specimen clamped at the ends and supported laterally by the standard FTM-406 jig. Author

N64-30698 Pennsylvania State U., University Park
EXPERIMENTAL INVESTIGATION OF PENETRATION IN FIBERGLASS REINFORCED PLASTICS Interim Technical Report No. 2
B. P. Gupta and Norman Davids 1 Jul. 1964 63 p refs
(Contract DA-31-124-ARO(D)-67)
(AROD-3842-2; AD-446522)

A comparison between steel and fiberglass-reinforced plastic for the weight per unit area required to stop a bullet has been carried out. The relations between energy loss of the bullet and thickness of the plate, the energy of the bullet and the thickness of the plate required to stop the bullet, and the thickness of the plate to stop the bullet and the density of the material have been found out. All these relations are linear. The effect of distance between two plates on the energy loss has also been discussed. A new and compact firing range has been developed. The impact of the projectile is made normal to the plate. The velocity of the projectile is found by oscilloscope using external triggering. Some possible errors in velocity measurement have been discussed. This method is applicable only for velocities up to 3,000 fps. Author

N64-30751 Brookhaven National Lab., Upton, N.Y.
SOME ANCIENT GLASS SPECIMENS WITH COMPOSITIONS OF PARTICULAR ARCHAEOLOGICAL SIGNIFICANCE
Edward V. Sayre Jul. 1964 28 p refs Sponsored by AEC
(BNL-879(T-354)) OTS: $0.75

Several hundred specimens have been chemically analyzed and provide a background of standard data on the composition of ancient glass artifacts. From this data, certain aspects of the technology by which an individual specimen is produced can be inferred. The raw material and, perhaps, its geographical origin often can be deduced. Analyses of a few particular specimens indicate conclusions of particular archeological interest. Emission spectroscopy, flame photometry, colorimetry, and X-ray fluorescence were used in obtaining the data. Sodium was determined by direct-flame photometric comparison of ancient glass with National Bureau of Standards specimens. One-milligram sample of glass were put into solution and diluted to 100 ml for these analyses. Phosphorus was determined by the molybdenum blue colorimetric procedure on solutions prepared from 10-mg specimens of glass. The remaining elements were determined by emission spectroscopy, with the exception that on one sample a nondestructive X-ray fluorescence method was used. R.L.K.

N64-30758 National Academy of Sciences-National Research Council, Washington, D.C.
POLYURETHANE COATINGS: USE AND PERFORMANCE An Annotated Bibliography
Hans Janecka, comp. Mar. 1964 15 p refs
(PDL-50915; AD-601279) OTS: $0.50

The annotated bibliography contains information on coating materials from polyurethanes—their preparation and properties; their uses as marine paints, aircraft materials, construction materials, linings for steel fuel-storage tanks, protective coatings, and the like; and their application. A.W.

N64-30930 Syracuse U. Research Inst., N.Y.
MATERIALS DESIGN HANDBOOK. DIVISION I: STRUCTURAL PLASTICS Technical Documentary Report, Nov. 1960–Feb. 1963
C. S. Grove, Jr., and R. Ford Pray, III Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 182 p
(Contract AF 33(616)-7736)
(ML-TDR-64-141; AD-604860)

This report is a design handbook for structural plastic applications in aerospace vehicles for the Air Force and contains a preliminary collection of technical data and information on these materials. Information is presented on topics such as material properties, theoretical analysis, design procedures, processing, and testing. Author

N64-30960 Atlantic Research Corp., Alexandria, Va.
BEHAVIOR OF NOZZLE MATERIALS UNDER EXTREME ROCKET MOTOR ENVIRONMENTS Quarterly Progress Report, May–Jul. 1964
J. D. Batchelor, J. B. Murphy, and E. L. Olcott Aug. 1964 16 p
(Contract NOw-64-0393-c)
(QPR-1; AD-605423)

Work was carried out on two experimental techniques, and preliminary results were obtained on two different materials. A plasma torch test technique, which exposes the bore of a tubular specimen to a high heat flux and a high velocity of selected gas mixtures, was conceived and developed. The necessary hardware was designed and constructed. The technique was proved satisfactory in tests of Graphitite-G grade of graphite with nitrogen, hydrogen, and carbon dioxide. The applicability of the tubular specimen geometry to refractory carbides was indicated by tests with NbC cylinders backed up with a graphite-carbide matrix. The equipment for the plasma-torch-impingement test method was renovated. Author

N64-31036 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
THE SUBLIMATION OF GRAPHITE AT HYPERSONIC SPEEDS
S. M. Scala and L. M. Gilbert Aug. 1964 79 p refs Presented at the AIAA Entry Technol. Conf., NASA. Langley Res. Center, 12–14 Oct. 1964
(Contracts AF 04(647)-269; AF 04(694)-222)
(R64SD55; AD-605199)

A new theoretical model is presented for the sublimation of graphite at hypersonic flight speeds. The aerothermochemical interactions between dissociated air and graphite are treated by means of a nine-component model, including O, O_2, N, N_2, CO, CO_2, C, C_3, and CN. The mass transfer rate, the heat transfer rate, and the skin friction coefficient are determined numerically and are then correlated by means of algebraic equations, as a function of stagnation pressure, stagnation enthalpy, and wall temperature in the high Reynolds number laminar flow regime. Author

N64-31130 Georgia Inst. of Tech., Atlanta Engineering Experiment Station
DESIGN AND DEVELOPMENT OF AN E-M WINDOW FOR AIR LIFT REENTRY VEHICLES Interim Engineering Report, 1 Mar. 1964–31 Jul. 1964
N. E. Poulos, C. A. Murphy, J. N. Harris, J. M. Wolf, and J. D. Walton, Jr. Wright-Patterson AFB, Ohio, AF Avionics Lab., 31 Jul. 1964 62 p refs
(Contract AF 33(657)-11504)
(IER-5; AD-447105)

Investigations were begun to develop higher strengths in slip-cast fused silica by the addition of alumina to the slip. Data generated to date indicate a transverse strength increase to the 5000 to 6000 psi (modulus of rupture) range with 4-point, quarter point loading. This is approximately 2 times the strength level of unmodified slip-cast fused silica. Resin-matrix filament-winding studies were continued. Compression strength determinations on 3/4-in.-diameter bars show an increase to approximately 2 times the unwrapped compression strength with 4 1/2 lb filament tension, and approximately 3 times with 8 pounds filament tension. Transverse strength measurements showed an increase to approximately 1.6 times the unwrapped nonresin-coated samples. Coatings of Cr_2O_3, ZrO_2, and HfO_2 modified slip-cast fused silica on unmodified slip-cast fused silica were evaluated for thermal performance in an oxy-acetylene torch facility. Author

N64-31249 Wyandotte Chemicals Corp., Mich. Industrial Chemicals Div.
SYNTHESIS OF LOW TEMPERATURE OIL RESISTANT URETHANE ELASTOMERS Annual Report, 1 Jul. 1962–30 Jun. 1963
S. L. Axelrood and W. J. Lajiness [1963] 32 p
(Contract DA-20-018-ORD-24883)
(AD-421811)

A number of diisocyanates, diamines, and polyether polyols were evaluated, and their relative concentrations were varied. There were comparatively small differences in the effect of type of diisocyanate and diamine on the low-temperature flexibility of the elastomers; however, they had a more pronounced effect on the oil resistance and mechanical strength, both at room and at elevated temperatures. Introduction of ethylene oxide into the polyether chain decreased the oil absorption at the expense of increased water absorption. Lowering the concentration of the polar urethane and urea linkages and the cross links was the key factor in attaining low-temperature flexibility. However, this had an adverse effect on mechanical strength and oil resistance. These concentrations were lowered by the use of higher molecular weight polyols and by reducing the relative concentration of diamine (NH_2/OH ratio). Large differences were observed in the low-temperature flexibility and other properties of the elastomers, depending on the positioning of the cross links and polar linkages. Author

N64-31269 Hanford Atomic Products Operation, Richland, Wash.
GRAPHITE BURNOUT MONITORING. PART I: MONITOR PREPARATION AND HANDLING TECHNIQUES
B. A. Ryan Jun. 1964 30 p refs
(Contract AT(45-1)-1350)
(HW-82436) OTS: $0.75

Standard dimensions for graphite oxidation monitors are 0.43 in. diam × 3.9 in. long. The monitors are machined from six well-identified bars of TSGBF graphite. All the monitors are cut parallel to the extrusion axis of the bars. Results from ashing representative samples from the six bars of TSGBF indicate that the monitors possess equivalent chemical purity. Two standard designs are used for the monitor carriers, one providing information on the depth of oxidation. All handling operations are with tongs or rubber gloves, and the monitors are always stored in a desiccator or in cardboard tubes to insure against contamination. Handling losses are insignificant. Desiccation before the initial and final weighing is considered important. Relative chemical reactivities toward air were determined for a number of graphites (KS, KC, CS, CSF, SGBF, CSGBF, and TSGBF) to allow comparisons between the various graphites in the Hanford reactors. Author

N64-31299 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
COMPRESSION-SET BEHAVIOR OF IRRADIATED SILICONE ELASTOMERS
E. G. Fritz and P. M. Johnson 15 May 1963 35 p refs
(Contract AF 33(657)-7201)
(NARF-63-2T; MR-N-301; AD-406689)

The effect of nuclear radiation (five different dose levels in the range of from 10^8 to 10^{10} ergs/gm(C)) on the compression-set behavior of three types of silicone elastomers (SE-551, SE-361, and DC-675) was examined. During the irradiation, the samples were compressed at constant strain in an air environment. The observed postirradiation precent compression set after an accumulated dose is described by an empirically derived equation. The ratio of the number of network chains at equilibrium with the unstrained thickness to the number of network chains at equilibrium with the applied strain rapidly decreases with dose. The Shore-A hardness of these elastomers was observed to increase with dose. Author

N64-31336* National Aeronautics and Space Administration, Washington, D.C.
MODERN CONCEPTS OF THE THERMAL STABILITY OF REFRACTORY CERAMIC MATERIALS AND MEANS OF INCREASING IT [SOVREMENNYYE PREDSTAVLENIYA O TERMICHESKOY STOYKOSTI OGNEUPORNOKERAMICHESKIKH MATERIALOV I PUTI YEYE POVYSHENIYA]
G. V. Kukolev and I. I. Nemets Aug. 1964 24 p refs Transl. into ENGLISH from Zh. Vses. Khim. Obshch. (USSR), v. 8, 1963 p 155–162
(NASA-TT-F-9065) OTS: $1.00

A survey of literature dealing with the thermal stability of refractory and ceramic materials is presented. Subjects included in the survey are these: (1) problems of thermal stresses in isotropic, homogeneous materials; (2) problems of thermal elasticity; (3) thermal shock-induced failure of ceramics; and (4) elastic properties of chrome–magnesite refractories. P.V.E.

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-30208 Joint Publications Research Service, Washington, D.C.
ON METHODOLOGICAL PROBLEMS OF TECHNICAL CYBERNETICS
G. S. Pospelov and V. A. Bokarev *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 1–14 refs (See N64-30207 22-01) OTS: $6.00

The philosophical relationship of cybernetics and dialectical materialism is discussed. Cybernetics, as a field, is broken down into areas of special interest, and technical cybernetics is defined in terms of its problems. In particular, the man-machine problem is treated at some length. D.E.W.

N64-30209 Joint Publications Research Service, Washington, D.C.
MINIMIZATION OF DESCRIPTIONS IN AUTOMATIC RECOGNITION OF SHAPES
Yu. L. Barabach *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 15–28 refs (See N64-30207 22-01) OTS: $6.00

The problem of automatic recognition of shapes is investigated on a theoretical information basis. A rule is given in general form for minimization of descriptions, based on evaluation of information properties of characteristics of recognized shapes. For certain properties of these signs the rule of minimization is simplified. For the case where the signs of the shapes do not permit absolute recognition, an evaluation is introduced of minimal description with respect to the required reliability of recognition. The relationship is shown between the rule of quantizing of values of the signs and the reliability of recognition. Author

N64-30210 Joint Publications Research Service, Washington, D.C.
ON MINIMIZATION OF PYRAMIDAL SYSTEMS OF MAJORITAL ELEMENTS

V. I. Varshavskiy and L. Ya. Rozenblyum *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 29–38 refs (See N64-30207 22-01) OTS: $6.00

Heuristic procedures are investigated that permit minimization of pyramidal systems during their synthesis from majorital elements. A simple algorithm is proposed for selection of the order of exclusion of variables for the synthesis of the system by the method of fixation of variables and the Cohn and Lindaman method, giving the average economic realizations. Author

N64-30211 Joint Publications Research Service, Washington, D.C.

ON A METHOD OF DECODING FOR THE BOSE-CHAUDHURI CODES WHICH CORRECT TRIPLE ERRORS

E. L. Blokh *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 39–50 refs (See N64-30207 22-01) OTS: $6.00

Procedures are indicated for simplifying the most labor-consuming operation in decoding the Bose–Chaudhuri codes. These are related to the determination of positions at which the number of errors occurring is not greater than three. Author

N64-30212 Joint Publications Research Service, Washington, D.C.

DETERMINATION OF OPTIMUM PERIODS OF PREVENTIVE MAINTENANCE IN AUTOMATIC SYSTEMS

Ye. Yu. Barzilovich *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 51–61 refs (See N64-30207 22-01) OTS: $6.00

An automatic system that operates continuously with a monotonically increasing function of breakdown intensity is investigated. The optimum period of planned preventive maintenance is determined under the condition that supplementary preventive maintenance is carried out immediately after a breakdown. An equation is obtained for the determination of the optimum period of preventive control for a system having constant breakdown rate. The discussion is illustrated by examples. Author

N64-30213 Joint Publications Research Service, Washington, D.C.

THE OPTIMUM RULE FOR MAINTENANCE OF A SYSTEM WITH MANY STATES

I. B. Gertsbakh *In its* Tech. Cybernetics, no. 3, 1964 10 Sep. 1964 p 62–70 refs (See N64-30207 22-01) OTS: $6.00

A system is investigated with reserve blocks having an exponential law of reliability. The system is subjected to checks according to a rule for the purpose of determining its state of repair. For the checking and detected breakdown, determinant losses are calculated where the losses in connection with a breakdown are proportional to the time, from the time of breakdown to the time of its detection. An optimul rule for maintenance is found that minimizes the average losses. Analytically, the problem is reduced to investigation of a system of linear equations of a special type. The theorem for existence and uniqueness of a solution of this system is proved, and an algorithm is given for finding the solution. Author

N64-30214 Joint Publications Research Service, Washington, D.C.

ON THE RELIABILITY OF RESERVED SYSTEMS DURING PERIODIC MAINTENANCE

Z. V. Malev *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 71–77 refs (See N64-30207 22-01) OTS: $6.00

The reliability of systems is investigated in which the occurrence and elimination of breakdowns of individual circuits (maintenance of the system) is carried out periodically. The period between two adjacent times of servicing is considered in the general case to be a random variable. A method is discussed for determination of the average time of correct operation before the first breakdown of the system. For two particular laws of distribution of the period between the times of maintenance, formulas for the average period of correct operation are derived. Author

N64-30215 Joint Publications Research Service, Washington, D.C.

A PROBLEM IN RELIABILITY THEORY

A. A. Sveshnikov *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 78–84 refs (See N64-30207 22-01) OTS: $6.00

Determination of the probability that the random function U(t) during the interval of time T will not go beyond the limits that ensure normal operation of the system is investigated. The problem is solved for the case where U(t) is a linear Markov process. Two numerical examples are considered that correspond to wide and narrow limits of the admissable values of the parameter of the system U(t). Author

N64-30216 Joint Publications Research Service, Washington, D.C.

ON AN ALGORITHM FOR OPTIMUM RESERVING OF AN APPARATUS

O. G. Alekseyev and V. I. Yakushev *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 85–95 refs (See N64-30207 22-01) OTS: $6.00

One possible means of using dynamic programing for selection of an optimum variation of reserving of an apparatus under certain limitations is investigated. A block diagram is presented of the algorithm for solution of the problem on a computer. Author

N64-30217 Joint Publications Research Service, Washington, D.C.

ON CONTROL BY THE MODULUS OF ARITHMETIC OPERATIONS

L. Z. Al'perovich and A. G. Shigin *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 96–100 ref (See N64-30207 22-01) OTS: $6.00

Organization of control with the use of several modules is proposed. Recommendations are given for the choice of a system of modules. The method is described for correction of an error, and an example is presented for related control. Control of floating-point numbers is investigated. Author

N64-30225 Joint Publications Research Service, Washington, D.C.

ON CALCULATION OF THE WEIGHT FUNCTION OF A PULSE SYSTEM BY A KNOWN PULSE TRANSFER FUNCTION OF A CONTINUOUS ACTION SYSTEM

A. N. Pokrovskiy *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 184–190 refs (See N64-30207 22-01) OTS: $6.00

A simple and effective method of calculation of the weight function of a linear pulse system by the known pulse transfer function of the corresponding continuous system is investigated. Estimates are made for increasing the moments of the weight function and for dispersions of errors of a pulse system by comparison with a continuous one. The case of a rational transfer function is investigated in detail. Author

N64-30233 System Development Corp., Santa Monica, Calif.
THE SAMPLING DESIGN FOR THE ROAM MONTE CARLO SIMULATION
Charles E. Clark and Betty Weber Holz 17 Jun. 1964 27 p refs (SP-1697/000/00; AD-443773)

This report pertains to the programing of a large stochastic simulation model for Monte Carlo analysis on a digital computer. The simulation model, which represents a forced march conducted by a mechanized unit, is described; the statistical sampling procedures are defined; and the efficiencies of the sampling procedures are estimated. I.v.L.

N64-30249 Portugal Nuclear Energy Commission, Sacavem Lab. de Fisica e Engenharia Nucleares
PROBLEMS ON THE INITIAL CONDITIONS IN THE THEORY OF DISTRIBUTION, I [PROBLEMAS COM CONDICOES INICIAIS NA TEORIA DAS DISTRIBUICOES, I]
J. Campos Ferreira and J. Silva Oliveira 1963 43 p refs In PORTUGUESE; ENGLISH summary
(LFEN-14 (α))

The first part of this work is devoted to the study of the regular differential system $du/dt = A(t)u+f(t)$, in the framework of the Schwartz theory of distributions; some results are obtained that can be considered as natural extensions of the classical theorems on the existence and uniqueness of the solution that satisfies given initial conditions. In the second part, after introducing the multiplication by Heaviside function H, use is made of this operation to study systems with constant but not necessarily regular coefficients. At the same time, a generalization is developed of a method of solution that probably can be useful in practice. Author

N64-30399 RAND Corp., Santa Monica, Calif.
NUMERICAL SOLUTION OF FUNCTIONAL EQUATIONS BY MEANS OF LAPLACE TRANSFORM-V: MISMATCHED SYSTEMS OF LINEAR DIFFERENTIAL EQUATIONS
R. E. Bellman, R. E. Kalaba, and J. Lockett May 1964 13 p refs
(Grant GM-09608-02)
(RM-4089-NIH)

The numerical solution of a system of linear first-order ordinary differential equations with given initial conditions can be complicated by the fact that the real parts of the eigenvalues may be significantly different. It is shown in this memorandum that the Laplace transform and numerical inversion can be used to overcome certain instability problems occurring in the numerical solutions of these differential equations. Author

N64-30400 System Development Corp., Santa Monica, Calif.
STOCHASTIC DUELS–III
Trevor Williams 22 Jun. 1964 73 p refs
(SP-1017/006100; AD-443754)

This report is concerned with the influence of letting each duellist "home" or "zero in" on his opponent during the course of the engagement. It is assumed that the conditional probability of a hit on the n^{th} round follows a Pascal distribution; this gives a spectrum of alternatives, whose lower end is the constant unconditional round hit probability. An expression for the overall hit probability is derived, and the behavior of this unconditional hit probability is examined. The notion of infinite homing is introduced. The nature of the general solution for small hit probabilities is investigated, and the complete solution is given for the case of exponential firing times. The technique for obtaining the maximum-likelihood estimate of the homing from field data is elaborated. The modifications to the solution of the duel entailed by infinite homing are set forth. The case where both homings are infinite is reduced to a double series, and a special case is found where the solution is expressible in terms of a Bessel function. All possible combinations of three orders of homing on each side are elucidated, and contour maps of the solutions are presented. Author

N64-30413 Joint Publications Research Service, Washington, D.C.
ORGANIZATION AND CONTROL OF COMPLEX INFORMATION
20 Aug. 1964 44 p refs Transl. into ENGLISH from Zh. Vychislitel'noy Mat. i Mat. Fiz. (Moscow), v. IV, no. 3, May–Jun. 1964 p 485–494, 525–543 refs
(JPRS-26013; TT-64-41283) OTS: $2.00

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3. ECONOMICAL ORGANIZATION OF INFORMATION SEARCH AND RETRIEVAL WITH EXTRA STORAGE V. V. Martynyuk p 32–41 ref

N64-30414 Joint Publications Research Service, Washington, D.C.
METHODS OF DYNAMIC PROGRAMMING IN THE THEORY OF OPTIMUM EQUATIONS. I: SYSTEMS PERMITTING USE OF THE CONTROL SCALE
N. N. Moiseyev *In its* Organ. and Control of Complex Inform. 20 Aug. 1964 p 1–16 refs (See N64-30413 22-20) OTS: $2.00

The direct solution of variational problems of optimum control, without reducing them to boundary-value problems, is considered. Problems include that of the minimum of the functional, boundary-value problems for the Lagrange equation, and problems for which the principles of L. S. Pontryagin's maximum are valid. A system for numerically solving variational problems is presented. D.E.W.

N64-30415 Joint Publications Research Service, Washington, D.C.
PROGRAMMING BASED ON CONTROL LAYERS AND THE STRUCTURE OF DIGITAL COMPUTERS
M. A. Osipova and Yu. A. Shreyder *In its* Organ. and Control of Complex Inform. 20 Aug. 1964 p 17–31 refs (See N64-30413 22-20) OTS: $2.00

Systematic descriptions of programing techniques are described, based on a certain set of control words and on digital-computer structure. Command words for point, straight line, and plane groups, predicates, timer control words, and command words for various functions of the computer subunits are discussed at length. D.E.W.

N64-30463 Lincoln Lab., Mass. Inst. of Tech., Lexington
THE PERIODIC ANALYSIS OF SAMPLED DATA
E. Korngold 15 Jun. 1964 53 p refs
(AD-601942) OTS: $1.50

A brief survey is given of some currently used techniques for periodic analysis of sampled data. Almost every periodic analysis of empirical data eventually relies on one of the following three techniques: (1) regression analysis on a trigonometric polynomial; (2) periodogram analysis; and (3) the estimation of power spectra. These techniques are best applied under distinct modeling assumptions, and an attempt has been made to discuss their applicability and their range of validity under various circumstances. Author

N64-30471 Hughes Dynamics, Inc., Los Angeles, Calif.
METHODOLOGIES FOR SYSTEM DESIGN Final Report
Ronald J. Ferris 24 Feb. 1964 97 p
(Contract AF 30(602)-2620)
(RADC-TDR-63-486; AD-434749)

This report presents the results of work on development, programing, and testing of methodologies for aiding information system design and evaluation. They include the following: (1) a first step in formalization of a "calculus of operations" developed for aiding definition of processes for file organization and searching; (2) the complete programs for an evaluation and assignment model, which provide for mechanized determination of the optimum assignment of components and functions to points in a hierarchial reporting structure; and (3) test results on the relative effectiveness (in terms of quality of results and time and cost for the design process) of the measure of system efficiency, the system design model, and the evaluation and assignment programs. Author

N64-30508* Martin Co., Baltimore, Md. RIAS Div.
CONTRIBUTIONS TO LINEAR SYSTEM THEORY
Leonard Weiss and R. E. Kalman Apr. 1964 62 p refs
(Contract NASw-845; DA-36-AMC-0221-X; AF 49(638)-1206)
(NASA-CR-58822; RIAS-TR-64-9; AROD-2603-12) OTS: $3.00 fs; $0.75 mf

This report presents a self-contained exposition of some important facets of linear system theory. Specifically, it is concerned with the class of dynamical systems that are governed by a set of linear ordinary differential equations of finite order in the state variables. New results are presented in the theory of control, observation, and canonical decomposition of such systems. These results are used in a detailed study of the relation of the state-variable representation of a system to certain well-known types of time-domain input–output representations. Author

N64-30540 Carnegie Inst. of Tech., Pittsburgh, Pa.
AVERAGINGS AND QUADRATIC EQUATIONS IN OPERATORS Technical Report No. 9
V. J. Mizel and M. M. Rao Oct. 1963 29 p refs
(Contract DA-36-061-ORD-447; NSF G-23721)
(CIT-ORD-16-TR-9; AROD-1230-10; AD-437748)

Bounded linear operators in Hilbert space satisfying general quadratic equations are characterized. Necessary and sufficient conditions for sets of operators satisfying two such equations to compare relative to a weak ordering are presented. In addition, the averaging operators in finite dimensional spaces are determined, and in this case it is shown that the averagings are unitary models for all projections. By a counterexample, it is pointed out that the latter result does not in general extend to the infinite dimensional case. Author

N64-30553 Hughes Dynamics, Inc., Los Angeles, Calif.
METHODOLOGIES FOR SYSTEM DESIGN Appendices to Final Report
24 Feb. 1964 236 p refs
(Contract AF 30(602)-2620)
(RADC-TDR-63-486; AD-434748)

The following appendixes are presented: (1) Evaluation and Assignment Programs—System Design Program, Input Forms, Detailed FORTRAN Program, and Testing of System Design Program; (2) File Organization Programs; (3) Document Activity Simulator and Simulation Program; (4) Word Association Program Flow Charts and Word Association and Activity Program; (5) Filer—Formalization of Description and Kernel Procedural Statement for Information Retrieval; and (6) Bibliography. Author

N64-30580 Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
BOUNDS ON DENSITIES AND HAZARD RATES
R. E. Barlow and A. W. Marshall Apr. 1964 29 p refs *Its* Math. Note No. 341
(Contract Nonr-222(83))
(DI-82-0338; AD-600973)

Sharp upper and lower bounds are derived for hazard rates and densities of distributions with monotone hazard rate. These bounds are related to Chebyshev inequalities in that they are obtained under the condition that certain moments are known. Similar bounds are also obtained when the density is a Polya frequency function of order two. Author

N64-30584 Brown Engineering Co., Huntsville, Ala.
A FORTRAN PROGRAM TO CALCULATE A SURFACE-TO-AIR MISSILE TRAJECTORY
C. F. Ostner, W. B. Warren, and H. S. Dupree Jun. 1964 63 p refs
(Contract DA-01-009-ORD-1068)
(TN-R-104; AD-602220)

This program computes a trajectory from launch or any point thereafter to any other time or to impact. Point masses and a nonrotating oblate spheroid earth are assumed. The program is written in FORTRAN IV and is used on the IBM 7040 computer. It will accommodate a one-, two-, or three-stage vehicle. Author

N64-30585 North Carolina State Coll., Raleigh Applied Mathematics Research Group
APPROXIMATE METHODS FOR THE SOLUTION OF CERTAIN DUAL FOURIER-BESSEL SERIES RELATIONS
Jerry A. Roberts 20 Jul. 1964 92 p refs
(Grant AF-AFOSR-444-64)
(AD-434416)

The dual Fourier–Bessel series relation

$$\sum_{n=1}^{\infty} \alpha_n^p \phi_n J_\nu(\alpha_n \rho) = f(\rho),\ 0 < \rho < 1,\ -1 \le p \le 1,$$

$$\sum_{n=1}^{\infty} \phi_n J_\nu(\alpha_n \rho) = 0,\ 1 < \rho < a,$$

is considered, where the sequence $\{\phi_n\}$ is to be determined. Dual series relations of this type occur in the investigation of stresses in a long elastic cylinder that contains a concentric penny-shaped crack. Numerical solutions for certain cases of this problem are obtained by the Cooke–Tranter solution and

by the Sneddon–Srivastav solution. Several methods for obtaining approximate solutions are developed. The errors incurred in using these approximations are discussed, and means of improving the original approximations are considered. Author

N64-30627 RAND Corp., Santa Monica, Calif.
APPLICATION OF A NEW APPROACH TO THE COMPUTATIONAL SOLUTION OF A SYSTEM OF TWO NON-LINEAR PARTIAL DIFFERENTIAL EQUATIONS
R. Bellman, R. Kalaba, and B. Kotkin Aug. 1964 16 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4240-PR; AD-603343) OTS: $1.00

A new method for integrating certain nonlinear partial differential equations was given previously. This method is applied to a system of two equations; numerical results are provided, including percent error; and FORTRAN listings are given. The nonlinear partial differential equations $u_t = uu_x + vu_y$, $u(x, y, o) = f(x, y)$ and $v_t = uv_x + vu_y$, $v(x, y, o) = g(x, y)$ are similar to those of hydrodynamics, exhibiting shocks, and have a simple representation for the solution. A numerical method of integration is proposed that preserves boundedness and positivity. Time and memory requirements are small. Author

N64-30649 Boeing Co., Seattle Wash. Mathematics Research Labs.
MODULES OF COHERENT BINARY SYSTEMS
Z. W. Birnbaum (Washington U.) and J. D. Esary Apr. 1964 34 p refs *Its* Math. Note No. 345
(DI-82-0344; AD-602324) OTS: $2.00

The concept of a module, i.e., a package of components of a system that can be removed and replaced as a whole, has been long in use in systems design and analysis. In this paper a formal definition of this concept is given and its properties are studied. Most of the results are obtained for coherent systems, i.e., for systems whose performance improves as the performance of their components improves. For such systems the relationship between modules and minimal paths can be fully clarified, and the results obtained lead to a criterion for deciding whether or not a given set of components constitutes a module of a given system. Author

N64-30650 California U., Livermore Lawrence Radiation Lab.
MONTE CARLO METHODS: A BIBLIOGRAPHY COVERING THE PERIOD 1949 TO 1963
Rose Kraft and Carl J. Wensrich 1 Apr. 1964 113 p refs
(Contract W-7405-ENG-48)
(UCRL-7823)

N64-30682 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SYMMETRIC LOADING OF ORTHOTROPIC SHELLS OF REVOLUTION Technical Report on Mathematics
C. R. Steele and R. F. Hartung Mar. 1964 58 p refs
(LMSC-6-74-64-5)

The problem of determining the stresses and deformation in a thin, homogeneous, orthotropic shell of revolution under the action of axisymmetric loads is reduced to the solution of a single inhomogeneous second-order linear differential equation with a complex dependent variable. Asymptotic solutions are obtained that are uniformly valid in both the steep and shallow regions of the dome-shaped shell. The complementary, or "edge-effect," solutions are expressed in terms of Thomson's functions of a noninteger order. The order depends both on the shape of the meridian curve at the apex of the shell and on the ratio of the elastic moduli. The particular solution is found in terms of an appropriate linear combination of the Lommel's function and Thomson's functions. Author

N64-30796 RAND Corp., Santa Monica, Calif.
NUMERICAL SOLUTIONS OF FUNCTIONAL EQUATIONS BY MEANS OF LAPLACE TRANSFORM. VII: THE MELLIN TRANSFORM
Richard Bellman Jul. 1964 11 p ref
(Grant NIH GM-09608-03)
(RM-4179-NIH; AD-603255) OTS: $1.00

This paper considers the question of the numerical inversion of the Mellin transform, $F(s) = \int_0^\infty u(t)t^{s-1}\,dt$. This transform plays an important role in the study of functional equations of the type that arise in matehmatical physics. Author

N64-30823 Astronautics Corp. of America, Milwaukee, Wis.
PROPELLANT ENERGY MANAGEMENT CONSIDERATIONS FOR THE FLIGHT DATA SYSTEM CONCEPT Technical Documentary Report, Feb. 1962–Feb. 1963
R. D. Seinfeld, D. E. Peterson, and M. A. Hoffman Wright-Patterson AFB, Ohio, Flight Dyn. Lab., May 1964 215 p refs
(Contract AF 33(657)-8430)
(ASD-TDR-63-259; AD-603006) OTS: $6.00

A digital computer program called the Captain Program has been prepared for solving a variety of flight control and instrumentation problems connected with space flight. The program has been written in FORTRAN. The building-block programming concept has been applied to two specific sample problems—earth orbital rendezvous and earth–moon flight. Verification has been obtained that the Captain Program is capable of generating several important types of space vehicle performance data with only minor changes in the input data including trajectory time history data, propellant utilization data, control techniques evaluation data, and control and instrument error analyses. Author

N64-30824 Louvain U. (Belgium)
TABLES OF BESSEL FUNCTIONS OF IMAGINARY ORDER
F. Buckens Dec. 1963 49 p refs
(Contract AF-EOAR-63-49)
(AD-602755) OTS: $4.00

The development of the Bessel functions is outlined, and their applications to problems involving annular thin plates and wave propagation is discussed. Also discussed are the definition and characteristics of the tabulated functions. P.V.E.

N64-30868 Los Alamos Scientific Lab., N. Mex.
NECKLACE: A COMPUTER PROGRAM CONCERNING THE TRANSIENT TEMPERATURES OF FISSIONING SPHERES IMBEDDED IN GRAPHITE
C. G. Chezem and W. R. Stratton 10 Sep. 1964 74 p refs
(Contract W-7405-ENG-36)
(LA-3115-MS) OTS: $1.75

The Necklace computer program describes the temperature-time–space relationship within a spherical volume in which contiguous spherical shells of graphite are heated by conduction from a central heat source. This source term may be in the central sphere and in an arbitrary number of adjacent spherical shells. Numbers and sizes of regions, specific heats, conductivities, and the radial and time magnitudes of the heat source terms are arbitrary. Author

N64-30892 Remington Rand Univac, St. Paul, Minn.
NUMBER SYSTEMS AND ALGORITHM STUDY FOR AN IMPROVED AEROSPACE DIGITAL COMPUTER Appendix
S. E. Tollefson et al Jul. 1964 73 p refs
(Contract AF 04(694)-433)
(EF-3765-3; AD-603118) OTS: $3.00

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1. NUMBER REPRESENTATION S. E. Tollefson p 1–24 refs
2. POLYNOMIAL MULTIPLY E. C. Herrmann p 25–30 refs
3. DIRECT AND INVERSE TRIGONOMETRIC FUNCTIONS E. C. Herrmann p 31–35 refs
4. THIRD ORDER MATRIX MULTIPLICATION E. C. Herrmann p 36–42
5. REPEAT FUNCTION POSSIBILITIES FOR POLYNOMIAL MULTIPLY AND SCALER PRODUCT S. E. Tollefson p 43–50
6. DOUBLE LENGTH MULTIPLY AND DIVIDE S. E. Tollefson p 51–71 refs

N64-30939 Johns Hopkins U., Baltimore, Md. Carlyle Barton Lab.
AN APPROACH TO THE DETERMINATION OF THE INTRINSIC DIMENSIONALITY OF A SIGNAL COLLECTION
R. S. Bennett Griffiss AFB, N.Y., RADC, Aug. 1964 31 p refs
(Contract AF 33(602)-2597)
(RADC-TDR-64-212; AD-605669)

The intrinsic dimensionality of a collection of signals is defined in terms of the minimum number of free parameters required in a hypothetical signal generator capable of producing a close approximation to each signal in the collection. A suggested computer program outline for estimating this dimensionality from the signal coordinates on an arbitrary orthogonal basis is developed. The program is based on some results from a related multidimensional scaling problem, and utilizes an inverse relationship between the variance in interpoint distances within a hypersphere, and the dimensionality of the hypersphere. The method is independent of the choice of orthogonal basis, and no prior knowledge of the analytical form of the signals is assumed. Data points themselves are used, with no attempt to infer a continuous approximating function. Author

N64-30958 Naval Radiological Defense Lab., San Francisco, Calif.
A SYSTEM FOR DEVELOPMENT OF MATHEMATICAL MODELS
J. W. Hendricks 23 Apr. 1964 64 p refs
(USNRDL-TR-749; AD-602733)

This paper presents a general quantitative system for association of theory and observation. A multivariable distribution approach to model construction is used in accounting for errors and other sources of variation. As usual, hypothesized mathematical descriptions are modified in accordance with the observational data. The requirement of a state of control is regarded as fundamental. The question of unidentifiability is given prominent consideration; and in this connection, the general necessity of calibration is established and emphasized. The principle of maximum likelihood is suggested as the most acceptable ranking criterion for the system; but modifications or decision-theory extensions are not precluded. Author

N64-30962 Stanford U., Calif. Computer Science Div.
CALCULATING THE SINGULAR VALUES AND PSEUDO-INVERSE OF A MATRIX
G. Golub and W. Kahan 4 May 1964 38 p refs Presented at the Matrix Symp., Gatlinburg, Tenn., Apr. 1964
(Contract Nonr-225(37))
(CS-8; AD-603116)

A numerically stable and fairly fast scheme is described to compute the unitary matrices U and V, which transform a given matrix A into a diagonal form $\Sigma = U^*AV$, thus exhibiting A's singular values on Σ's diagonal. The scheme first transforms A to a bidiagonal matrix J, then diagonalizes J. The scheme is complicated but does not suffer from the computational difficulties that occasionally afflict some previously known methods. Some applications are mentioned, in particular the use of the pseudoinverse $A^I = V \Sigma^I U^*$ to solve least-square problems in a way that dampens spurious oscillation and cancellation. Author

N64-30968 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ON CERTAIN PROCEDURES OF THE RUNGE-KUTTA TYPE FOR THE NUMERICAL INTEGRATION OF THE DIFFERENTIAL EQUATION $y' = f(x,y)$
A. Cotiu and F. Cotiu 10 Aug. 1964 10 p refs Transl. into ENGLISH from Studia Univ. Babes-Bolyai, Ser. i, (Cluj, Rumania), no. 1, 1961 p 157–162
(RSIC-243; AD-605381)

Some procedures of the Runge–Kutta type are given in this paper for the numerical integration of the first-order differential equation $Z' = \phi(x,z)$ with the initial condition $Z(x_0) = Z_0$. The authors assume the conditions are satisfied for existence and uniqueness of the integral Z(X) in the interval $[X_0, X]$ where $X = X_0 + h$. A.W.

N64-30970 General Electric Co., Washington, D.C. Information Systems Operation
APPLICATIONS OF SERIAL AND PARALLEL FILE STRUCTURES TO COMMAND AND CONTROL SYSTEMS
Stanley B. Rosen, John P. Mc Cabe, and Essie S. Nevans Bedford, Mass., Electron. Systems Div., Aug. 1964 40 p refs
(Contract AF 19(628)-3843)
(ESD-TDR-64-519; AD-604862)

This study was undertaken to determine if the introduction of redundant files can reduce search time when serial outputs are required. Serial and parallel file structures on magnetic tape and disc memories were studied. It was concluded that search time can be improved because of the inherent random-access features of disc memory. Author

N64-30978 Wisconsin U., Madison Mathematics Research Center
EQUIVALENT CLASSES OF SINGULAR PERTURBATION PROBLEMS
W. A. Harris, Jr. Aug. 1964 21 p refs
(Contract DA-11-022-ORD-2059)
(MRC-502; AD-605652)

In many problems, usually called singular perturbation problems, differential equations of the form (1) $\epsilon^H dy/dx = A(x, \epsilon)\, y$ are encountered where $A(x, \epsilon)$ is an n-by-n matrix analytic in x and ϵ, and H is a diagonal matrix with entries that are nonnegative integers. General analytic reduction theorems for the form (2) $\epsilon^h dy/dx = A^*(x, \epsilon)y$ where h is a scalar, have been given by Y. Sibuya. Recently W. Wasow has shown that the additional knowledge represented by the formulation (1) can

be used to advantage to obtain a refined analytic decomposition under "comparatively mild hypotheses concerning the non-vanishing of certain minors of A(x, 0)". By reformulating these hypotheses and studying equivalent classes of problems of the form (1), it is shown that Wasow's results are "best possible." Author

N64-31007* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTATIONAL INVARIANCE OF MAXWELL'S EQUATIONS
William C. Orthwein 4 Jan. 1964 19 p refs Reprint (NASA-RP-324)

It is shown that Maxwell's vector equations are rotationally invariant in the usual sense; that is, they assume the same vector form in each of two orthogonal coordinate systems, which experience a relative angular velocity. This conclusion depends upon the well-known invariance of the Minkowski tensor formulation of Maxwell's equations and upon the heretofore uncertain orthogonality and flatness of space–time as seen by a rotating observer. Because there has been some question in the past regarding the curvature of the rotating space, this matter is first resolved by pointing out an apparently unnoticed but, nevertheless, fundamental distinction between transformations in space only and those in space–time. Once the properties of space–time transformations are established, it then follows that the rotating space is Euclidean even though time and circumferential distance undergo Lorentz contractions. Author

N64-31033 System Development Corp., Santa Monica, Calif.
PROCEEDINGS OF THE SYMPOSIUM [ON] DEVELOPMENT AND MANAGEMENT OF A COMPUTER-CENTERED DATA BASE
A. Walker, ed. 6 Jan. 1964 140 p Conf. held on 10–11 Jun. 1963; sponsored by ARPA

Subjects discussed include military decision-making and data requirements, data retrieval for the Strategic Air Command Control System (SACCS), experience in managing data-base operations, a computer-centered data base for military personnel managers, automated data management, and adaptation of mass storage equipment for handling of a data base. Various work sessions are reported on, and a summary of unsolved problems is appended. D.E.W.

N64-31037 Joint Publications Research Service, Washington, D.C.
MATHEMATICAL PROBLEMS OF CYBERNETICS AND COMPUTER TECHNOLOGY
L. V. Kazaryan et al 6 Oct. 1964 81 p refs Transl. into ENGLISH from Tr. Vychislite'nogo Tsentr. Akad. Nauk Armyansk. SSR i Yerevanskogo Gos. Univ. (Yerevan), 1963 (JPRS-26740; TT-64-41997) OTS: $3.00

From a collection of articles, the data reported include distinctions between basic and subordinated variables in logico–mathematical languages; logical productivity and effectiveness of controlled digital computers; optimum relationship between capacities of different types of operational memory; and the normalization of graph–diagram algorithms. A.W.

N64-31038 RAND Corp., Santa Monica, Calif.
SOME DIRECTIONS OF RESEARCH IN DYNAMIC PROGRAMMING
Richard Bellman Apr. 1964 19 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3661-PR; AD-438438)

In this paper are indicated areas of research and some interesting and significant problems that arise in the attempt to use a certain functional equation as an effective algorithm in the study of multistage decision processes. Author

N64-31072 RAND Corp., Santa Monica, Calif.
NONLINEAR EXTRAPOLATION AND TWO-POINT BOUNDARY VALUE PROBLEMS
Richard Bellman, Harriet Kagiwada, and Robert Kalaba Apr. 1964 13 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4079-PR; AD-435765)

It is suggested that the convergence properties of the usual Picard successive approximation scheme may be improved through use of nonlinear extrapolation techniques. A numerical example is provided. Author

N64-31099 University of Southern Calif., Engineering Center Los Angeles
NONLINEAR ESTIMATION THEORY
In its Res. in Opt. Coherence and Nonlinear Estimation Theory Dec. 1963 p 46–109 refs (See N64-31097 22-08)

This report is concerned with the estimation of the dynamic states of a nonlinear differential equation that is quasi-linear in the vector function $x = f(x)$. In general, the optimal Bayes estimator ($X^*(t_e)$ minimizes the expected value of any symmetric positive semidefinite quadratic loss function defined on the error $x(t_e) - x^*(t_e)$. This optimal estimator is approximated by the state $\bar{x}(t_e)$, which maximizes the a posteriori density function conditioned on L vector measurements. The a posteriori density function, for an assumption of gaussian measurement noise and a priori statistics, is represented by a constant multiplying on exponential function of a positive definite quadratic form. This quadratic function $\phi_e(Z_L, \hat{x}(t_e))$, when minimized, maximizes the a posteriori density function where Z_L denotes the set of L vector measurements. Author

N64-31109 Auerbach Corp., Philadelphia, Pa.
QUANTITATIVE METHODS FOR INFORMATION PROCESSING SYSTEMS EVALUATION Final Report, Mar. 1963–Jan. 1964
Alan Taylor, John R. Hillegass, and Norman Statland Bedford, Mass, AFSC, Electron. Systems Div., Jan. 1964 291 p
(Contract AF 19(628)-2838)
(ESD-TDR-64-194; AD-435557)

This research was directed toward determining whether computer system timings could be simply estimated, with reasonable accuracy, using only standardized descriptions of a computer system and an application. In the course of the research, determination of those elements of a computer and associated programs that are critical to overall timing were to be indicated. This research demonstrates that the approach is feasible. The conclusion is supported by the development of the VECTOR process for readily estimating computer processing times. The system permits prediction of time estimates to process a given application on a specific computer within ±15%. Author

N64-31201* National Aeronautics and Space Administration, Washington, D.C.
THE NUMERICAL METHOD OF INTEGRAL RELATIONS

O. M. Belotserkovskiy and P. I. Chushkin Jan. 1963 41 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. II, no. 5, Sep.–Oct. 1962 p 731–739 Presented at a Conf. on Math. Methods in Gas Dyn., Computer Center of the Acad. of Sci. USSR, 23 Mar. 1962
(NASA-TT-F-8356) OTS: $2.00 fs, $0.50 mf

A. A. Dorodnitsyn, in developing the method of straight lines, proposed the method of integral relations, which reduces the integration of systems of nonlinear partial differential equations to the solution of an approximation by ordinary differential equations. In the method of integral relations, the region is laid off into areas by curves, the forms of which are determined by the form of the boundary of the integration region; the freedom in the choice of the approximating functions makes it possible to obtain an accurate solution even with a small number of strips. This report describes the fundamentals of the method of integral relations and its applications, introduces different schemes for constructing the approximating systems, and solves some problems in gasdynamics using this method. E.K.R.

N64-31207* Seton U., South Orange, N.J.
THE ALGEBRAIC STRUCTURE OF THE N-BODY PROBLEM
L. M. Rauch Washington, NASA, Oct. 1964 37 p refs (Grant NsG-413)
(NASA-CR-111) OTS: $1.00

It is found that the union of initially disparate subgroups leads to a group whose properties are the formal tools that formulate the explicit solutions of the *n*-body problem. A brief indication of the applications of this evolved algebra is given. Author

N64-31262 Pacific Missile Range, Point Mugu, Calif. Operations Research Group
ON THE AVERAGING OF REDUNDANT MEASUREMENTS FOR MAXIMUM PRECISION
M. L. Eaton 11 Jan. 1963 31 p refs
(PMR-TM-63-12; AD-420844)

A method is derived for obtaining a weighted average of several redundant measurements of a common vector quantity so as to obtain the estimate of the vector with minimum error "variance." The method is general in the sense that the individual measurements may have unequal precision and may be error-correlated with each other, and that measurements of the individual vector components may be made with unequal precision and with all possible correlations of error. The method is applied to a specific submarine-locating problem, where the submarine's position is to be estimated by use of hydrophones and a depth sensor. The results of using both weighted averages and simple averages are compared. Author

N64-31331* National Aeronautics and Space Administration, Washington, D.C.
USE OF QUATERNIONS IN THE REPRESENTATION OF ANGULAR COORDINATES [UTILISATION DES QUATERNIONS POUR LA REPRESENTATION DES COORDONNEES ANGULAIRES]
Lucien Abadie Aug. 1964 12 p refs Transl. into ENGLISH from a paper presented at the Intern. Symp. on Analogue and Digital Tech. Appl. to Aeron., Liège, 9–12 Sep. 1963
(NASA-TT-F-9101) OTS: $1.00 fs; $0.50 mf

The classical representation of the angular coordinates of an aerodyne by means of Euler angles can be advantageously replaced, in the mathematical models of flight mechanics, by the use of the four homogeneous components of the quaternion of unit modulus associated with the space rotation, which brings the frame bound to the moving body onto the fixed frame. A comparison of the analytical expression of the three differential equations of angular motion with the matrix of transformation of coordinates shows this method to be particularly effective in the numerical integration of motion on a data processing machine. The results are transposed into classical representation systems by means of simple formulas. Author

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-30373 Joint Publications Research Service, Washington, D.C.
THE RELATIONSHIP BETWEEN TYPES OF SYNOPTIC PROCESSES AND TURBULENCE IN THE UPPER TROPOSPHERE OVER TRANSCAUCASIA
V. P. Lominadze 23 Sep. 1964 8 p refs Transl. into ENGLISH from Tr. Tbilissk. Nauchno-Issled. Gidrometeorol. Inst. (Tbilisi), no. 8, 1962 p 113–116
(JPRS-26523; TT-64-41781) OTS: $1.00

From a comparison of the frequency of turbulence in the lower and upper troposphere over Transcaucasia, it is concluded that the maximum percent of frequency of turbulent flow in both the lower and upper troposphere is observed in type I synoptic processes (38.2% and 41.04%, respectively). This turbulence is characterized by the passage of cold fronts from the west, in which there is intrusion of cold airmasses into Transcaucasia on the rear of fronts. At the time of type II synoptic processes, the frequency of turbulent flow in the lower troposphere over Transcaucasia is 4.3%, and in the upper troposphere it is 17.33%. The frequency of turbulence in the lower and upper troposphere at the time of type III synoptic processes is 25.20% and 25.03%, respectively. P.V.E.

N64-30479 Agricultural Research Service, Tempe., Ariz. Water Conservation Lab.
ENERGY BALANCE STUDIES OVER SUDANGRASS, 1962 Interim Report, 5 Jun.–18 Sep. 1962
C. H. M. van Bavel and L. J. Fritschen Mar. 1964 49 p refs (AD-447818)

During 1962 the energy balance of a sudangrass crop was continuously studied from 5 June through 18 September in Tempe, Arizona. Hourly or half-hourly measurements were made of evaporative flux, net radiation, soil heat flux and sensible heat exchange—the latter by difference. Detailed energy balances are given for 16 periods of 24 hours, each of special interest. Daily balances are given for the entire period of observation, except where unavoidable interruptions occurred. Author

N64-30512* Meteorology Research, Inc., Altadena, Calif.
DETAILS OF WIND STRUCTURE FROM HIGH RESOLUTION BALLOON SOUNDINGS

Robert Stinson, A. I. Weinstein, and E. R. Reiter Huntsville, Ala. NASA. Marshall Space Flight Center, 24 Aug. 1964 30 p refs
(Contract NAS8-5294)
(NASA-TM-X-53115) OTS: $2.00 fs; $0.50 mf

The tracking of spherical superpressure balloons by an FPS-16 radar has generated accurate data concerning the winds in the upper troposphere and lower stratosphere. Above about 11 km the winds are obtained to high resolution, while below this altitude spurious balloon motions mask the fine structure of the wind although the gross features of the wind are still accurately displayed. All the soundings, covering various meteorological situations, show a large amount of microstructure in the wind field above the tropopause, with shears of 2 mps/100 m being observed on all soundings, shears exceeding 5 mps/100 m being observed occasionally, and with the speed (and direction) variations tending to occur with vertical wavelengths of 0.5 to 2 km. The shears occur at an altitude range and are of a magnitude and wavelength where they can significantly affect vertically rising rocket launch vehicles.
Author

N64-30566 Aracon Geophysics Co., Concord, Mass.
FLEET APPLICATIONS METEOROLOGICAL OPERATIONAL SATELLITES (ANTARCTIC AREA) Final Report, Jul. 1–Oct. 31, 1962
Earl S. Merritt 15 Aug. 1963 72 p refs
(Contract N189(188)-56507A)
(ARA-F-9228-2; AD-415962)

Techniques have been developed for extracting operationally useful meteorological information from satellite-observed cloud patterns. These techniques are designed to provide useful data on the following: (1) field of motion of the lower and upper troposphere; (2) cyclonic vortex intensity, development, and direction of future motion; and (3) differentiation of cloud from snow and snow-covered ice. The techniques reported here were specifically developed to provide meteorological information for support of the Antarctic resupply operations.
Author

N64-30622 Bollay (E.) Associates, Inc., Santa Barbara, Calif.
NATIONAL AVIATION METEOROLOGICAL REQUIREMENTS THROUGH 1975 Final Report
D. Zopf Feb. 1964 69 p
(Contract FA-WA-4403)
(RD-64-31; AD-600109) OTS: $3.00

This report is the first up-dating of detailed operational requirements for aviation weather service. Sections have been added that define the relative priority of different services, products, and meteorological parameters in aviation operations; discuss user application of forecast accuracy information; define operational weather products and their distribution; and describe needed methods for presentation of operational information.
Author

N64-30660 Joint Publications Research Service, Washington, D.C.
ARTIFICIAL MODIFICATION OF CLOUDS AND FOG
B. V. Kiryukhin and P. N. Krasikov 25 Sep. 1964 39 p refs Transl. into ENGLISH from the book "Dozhd' i Sneg Po Vole Cheloveka", Leningrad, State Meteorol. Publ. House, 1963 p 117–164
(JPRS-26561; TT-64-41819) OTS: $2.00

Various proposals and tests made in connection with weather control are described, and the present status of the problems involved is discussed. The following types of artificial weather influences are discussed: (1) influences affecting fogs; (2) influences affecting the supercooling of clouds; and (3) influences affecting clouds at above-freezing temperatures.
P.V.E.

N64-30810 Wisconsin U., Madison
A COMPARISON OF THE HEAT BALANCE OF LAKES IN WINTER
Jon T. Scott Apr. 1964 151 p refs
(Contract Nonr-1202(07))
(TR-13; AD-603347) OTS: $5.00

Study of 53 lakes in Wisconsin during the winter of 1962–63 shows that differences of lake morphometry produce large lake-to-lake variations in many of the heat-balance terms and in ice phenology. Lake depth and size are the most significant morphometric features influencing heat balance and phenology. The mean temperature of the water on the lake closing date and maximum ice thickness are significantly correlated with mean fetch of the lakes. A multiple regression analysis shows that mean depth is not significantly correlated with these two factors. Lake depth influences the change in mean temperature of the water, especially during cooling and for a short period after opening. A detailed comparison of the heat balance of nine lakes shows that lake-to-lake differences in maximum ice thickness of as large as 20 cm are most probably produced by differences in heat flow from the water to the ice and by exchange of heat with the atmosphere.
Author

N64-30875 Joint Publications Research Service, Washington, D.C.
ON THE CALCULATION OF NON-ADIABATIC PROCESSES IN NUMERICAL SHORT-RANGE PRESSURE FORECASTING
S. A. Mashkovich 30 Sep. 1964 14 p refs Transl. into ENGLISH from Tr. Tsentral. Inst. Prognozov (Moscow), no. 126, 1963 p 38–46
(JPRS-26639; TT-64-41897) OTS: $1.00

A forecasting scheme is presented that makes possible calculation of the effect of nonadiabatic factors on the development of large-scale atmospheric processes. The starting equations are the vorticity and the heat-flux equations. In the equation of heat flux, together with terms describing temperature advection and the effect of vertical motions, terms are used that describe radiation heat transfer, horizontal heat transfer, and heat transfer due to condensation. In the equation of heat flux for the boundary layer of the atmosphere, turbulent mixing along the vertical is also considered. The vertical velocity component in the lower layer is assumed as being proportional to the Laplacian of the geopotential. The solution obtained for the surface layer is used as the boundary condition for the equations in the free atmosphere. These equations are written in finite differences for a three-level model of the atmosphere and are reduced to a canonical form. The solution of the system obtained is sought numerically by means of the iteration method.
I.v.L.

N64-30998* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
POWER SPECTRAL MEASUREMENT OF ATMOSPHERIC TURBULENCE IN SEVERE STORMS AND CUMULUS CLOUDS
Richard H. Rhyne and Roy Steiner Washington, NASA, Oct. 1964 50 p refs
(NASA-TN-D-2469) OTS: $1.25

The report summarizes power spectral data of atmospheric turbulence obtained from recent flights in severe storms and

cumulus clouds. For completeness, previously published spectra are included. These spectra are similar in shape to those obtained in clear air at altitudes below 5,000 ft. The power varies inversely with frequency to the five-thirds power. As an indication of the turbulence intensity, values of root-mean-square gust velocity determined from the measured spectra ranged from approximately 6 to 16 fps for the severe-storm traverses and from about 3 to 9 fps for the cumulus-cloud traverses. Storm turbulence was found to be homogeneous and stationary, isotropic, and gaussian to a degree sufficient for many practical applications. Values of L, a scale parameter required in the analytical representation of the spectra, were obtained for five storm traverses. The values obtained range from approximately 2,700 to 5,600 ft. Author

N64-31022 Joint Publications Research Service, Washington, D.C.
COMPUTER PROGRAMMING IN METEOROLOGY
M. V. Zavarina and M. I. Yudin 5 Oct. 1964 72 p Transl. into ENGLISH of chapters 8 and 9 from the book "Schetnyye Mashiny v Meteorologii" Leningrad, 1963
(JPRS-26693; TT-64-41950) OTS: $3.00

A discussion of the basic types of meteorological problems requiring the use of computers includes the following: (1) a quasi-geostrophic model of the short-range prognosis of pressure, wind, and temperature fields; (2) methods of computation using barotropic models; (3) nongeostrophic models; (4) prognosis of meteorological elements in the boundary layer of the atmosphere; and (5) objective analysis of meteorological fields—statistical analysis. Examples of programs of meteorological problems include the following: (1) computing thermal advection; (2) solving the Helmholtz equation by the iteration method; (3) solving the transport equation; and (4) operative analysis and prognosis of geopotential at three atmospheric layers. E.K.R.

N64-31154 Denver Research Inst., Colo.
BALLOON FLIGHT OF OCTOBER 29, 1962, VOLUME I: IR DATA Flight Data Report No. 11
David G. Murcray, James N. Brooks, Jay O. Green, and Marie M. Working 10 Sep. 1963 394 p
(Contract AF 33(616)-7633)
(AD-421461)

This report presents the results obtained on a balloon flight made with an automatic programed radiometer system. The radiometer was equipped with a liquid-oxygen-cooled InSb cell as a detector, and measurements were made of the infrared background radiation in various wavelength intervals between 1.8μ to 5.0μ. Author

N64-31156 Aracon Geophysics Co., Concord, Mass.
ANALYSES IN THE FIELD OF SATELLITE METEOROLOGY, PART I (SUMMARY) Final Report
William K. Widger, Jr. Bedford, Mass., AFCRL, 31 Jul. 1963 12 p refs
(Contract AF 19(628)-320)
(AFCRL-63-843; AD-422285)

A summary of research and development analyses in the field of satellite meteorology is presented. Topics discussed include the following: (1) analysis of terrestrial features as seen by TIROS, and construction of a landmark map portraying these features for the area of the continental United States; (2) development of a modification and improvement of the Fujita method of TIROS picture location and rectification; (3) preliminary development of techniques for the geographic referencing of data from the Nimbus Automatic Picture Transmission System; (4) initial studies toward a tropical storm development model based on TIROS photographs; (5) analyses of stratiform cloud patterns in the Canary Islands area; and (6) a listing of reports covering these analyses. Author

N64-31161 Oregon State U., Corvallis Science Research Inst.
INVESTIGATION OF INSTRUMENTATION AND TECHNIQUES FOR ARMY WEATHER OBSERVATION Final Report, 1 Feb. 1962–31 Mar. 1963
Fred W. Becker et al [1963] 98 p refs
(Contract DA-36-039-SC-89186)
(Rept.-4; AD-421406)

A literature search was conducted for material relating to the instrumentation of the AN/CPS-9 for automatic weather data recording. Much of the instrumentation determined necessary for automatic weather data recording by the AN/CPS-9 was implemented. This instrumentation included modification and additions to the RHI camera and bezel assembly; acquisition, installation, and testing of oscillorecording equipment for the study of single pulse radar return (SPRAR); design, construction, installation, and testing of the automatic step-gain control and associated indicating equipment; and the acquisition, installation, and testing of radar system calibration equipment. Data obtained from a detailed surface meso-meteorological network included drop-size samples, pressure, temperature, precipitation charge, and earth–air current. Author

N64-31177 University Coll., Galway (Ireland)
ATMOSPHERIC CONDENSATION NUCLEI AND TRACE GASES Final Technical Report, 1 Jan.–31 Dec. 1962
[1962] 65 p refs
(Contract DA-91-591-EUC-2126)
(AD-420435)

This report deals mainly with investigations of the origin and nature of the Aitken nuclei found in the atmosphere, i.e., with the condensation nuclei in the size range below approximately 2×10^{-5} cm. The following are discussed: (1) atmospheric condensation nuclei—terminology and methods; (2) condensation nuclei and meteorological conditions; (3) ionization balance in the atmosphere—in urban and in maritime air; (4) sources of condensation nuclei—field and laboratory experiments, nuclei and gases from heated wires, and combustion nuclei; (5) trace gases in the atmosphere—sulfur dioxide and nitrogen dioxide. E.K.R.

N64-31197 Meteorology Research, Inc., Altadena, Calif.
STUDY & MODIFICATION OF CONVECTIVE STORMS Second Interim Report, Apr. 1–Jun. 30, 1963
P. M. Mac Cready, Jr. and T. J. Lockhart [1963] 30 p
(Contract DA-36-039-SC-89066; ARPA Order 265-62)
(MRI63-IR-87; AD-421182)

This interim report describes the results of the preparation phase of the second year of the current program of basic research in cloud physics, cloud dynamics, and related cloud modification. The subjects described are as follows: (1) General Cloud Microphysics and Dynamics Study; (2) Cloud Cell Dynamics and Edge Study; (3) Seeding; (4) Droplet Concentrations; (5) Mountain Wake Effects; (6) Thermal Roots Relative to Mountains; (7) Cloud Area Dynamic Effects; (8) Cloud and Precipitation Development Census; (9) Thunderstorm Created Cold Front; (10) Electrification; (11) Freezing Nuclei; and (12) Technique Development. Author

N64-31217* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
CLOUD HEIGHTS AND NIGHTTIME CLOUD COVER FROM TIROS RADIATION DATA
S. I. Rasool Repr. from J. Atmospheric Sci., v. 21, no. 2, Mar. 1964 p 152–156 refs
(NASA-RP-340)

The daytime and nighttime data are separately treated. Close correlation is found between the global distribution of the average effective temperatures, measured by the 8μ to 12μ channel of the satellite radiometer, and the cloud-cover data. An estimate of the latitudinal distribution of cloud heights is obtained using Tiros daytime radiation data together with the cloud-cover distribution from Tiros photographs. The latitudinal distribution of nighttime cloud cover is determined from these values of cloud heights in combination with the nighttime radiation data. The results indicate that in the Southern Hemisphere the percentage of cloudiness at night is considerably higher than during daytime, whereas in the Northern Hemisphere the cloudiness appears to decrease at night. IAA

N64-31256 Miami U., Coral Gables, Fla. Inst. of Marine Science
RADAR HURRICANE RESEARCH Final Report, 1 Jul. 1962–31 Aug. 1963
H. V. Senn, J. A. Stevens, and H. W. Hiser Sep. 1963 81 p refs
(Contract Cwb-10507)
(AD-421622)

Considering the state-of-the-art and limitations of size, weight, and power requirements for radar equipment used in aircraft, the important major radar characteristics are examined on a theoretical basis. Based upon this study an attempt is made to determine the optimum parameters for airborne weather reconnaissance radars that might possibly be used on research aircraft in various conditions of flight. Characteristics of a combined 5-cm and 3-cm radar, which seem to be optimum for the existing as well as future weather reconnaissance data gathering missions, are described. Some other desirable additions, such as receiver characteristics that provide for gathering more quantitative radar weather data and for the optimum presentation of weather in the presence of ground and sea clutter on the radarscope, are also described. In addition to the above radar equipment studies, analysis of the echo motion about Hurricane Donna on 9 and 10 September 1960 has been continued. Author

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-30229 Joint Publications Research Service, Washington, D.C.
ON THE SECOND GROUP OF ERRORS IN INERTIAL NAVIGATION SYSTEMS
V. D. Andreyev *In its* Tech. Cybernetics, No. 3, 1964 10 Sep. 1964 p 243–248 refs (See N64-30207 22-01) OTS: $6.00

Error equations are investigated for inertial systems of autonomic coordinate determination of an object. The equations were set up with the consideration of basic instrument errors. Under the assumption that the motion of the object in an established system is given with respect to time, the equations of the second group are integrated in quadrants that determine the errors in calculation of the coordinates caused by instrumental errors equivalent to the free withdrawals of gyroscopes of the system. Author

N64-30551 George Washington U., Washington, D.C. Human Resources Research Office
PICTORIAL NAVIGATION DISPLAYS AND LOW ALTITUDE NAVIGATION Consulting Report
Robert H. Wright and Thomas G. Waller Apr. 1964 13 p
(Contract DA-44-188-ARO-2)
(AD-601711)

Described are what a pictorial navigation-display system for use in Army aviation should do, how it should look, and what tactical and training implications such a device might have. Evaluated in these terms are the ACF RT-1B, Bendix's Position Fixing Navigation System (PFNS), and Bendix Air Navigation Display System (BANDS). None of the three met all the major requirements. Potential modifications of the ACF RT-1B for Army tactical use at very low altitudes are suggested. R.L.K.

N64-30653 Aerospace Corp., El Segundo, Calif. Electronics Div.
APPLICATION OF NEAR OPTIMUM GUIDANCE EQUATIONS OVER TWO BOOSTER PROPULSION STAGES OF ANY SPACE BOOSTER
F. M. Perkins 15 Jul. 1964 13 p ref
(Contract AF 04(695)-269)
(TOR-269(4540-70)-3; AD-602698) OTS: $1.00

Explicit guidance equations for a near-optimum pitch-steering technique were developed by the author and have been presented in the report, "Optimum Guided Ascent." These equations were developed for only one stage of the flight. In the present report, additional equations are presented that are necessary to simplify the application of the single pitch program across two thrust stages. These guidance equations can then be mechanized for explicit guidance during the guidance phase of the first stage and, in addition, for the entire second stage; or, alternatively, they can be used on a general-purpose computer before flight to determine the nominal optimum pitch-time equation that could then be flown open loop up to the initiation of the final propulsive stage, that would then be flown closed loop, using the explicit solution given in "Optimum Guided Ascent." I.v.L.

N64-30776 Raytheon Co., Bedford, Mass. Space and Information Systems Div.
OPTIMAL REENTRY GUIDANCE STUDY. PART II: COMPUTER PROGRAM Final Report
Joan Sheehan 31 Jul. 1964 244 p ref
(Contract AF 04(695)-348)
(BR-3060-2; AD-603242)

The Optimal Reentry Guidance Study program (ORG) is a large digital-computer program written in the FORTRAN IV language. The program is designed to allow for as much flexibility as possible, so that sections can be changed conveniently. A description of the computer program is presented; a discussion is given of the general organization of the program; and flow diagrams, program symbols, and program listings are included. P.V.E.

N64-31006* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATOR STUDY OF A TURN PROCEDURE FOR REDUCING AIRSPACE REQUIREMENTS FOR SUPERSONIC TRANSPORTS
Richard H. Sawyer Repr. from J. Aircraft, v. 1, no. 3, May–Jun. 1964 p 159–160 ref
(NASA-RP-323)

The SST is simulated by a fixed-based single-place cockpit and an analog computer arrangement. The equipment in the cockpit includes the usual aircraft controls, with the exception that a side-arm controller is used for longitudinal and lateral control. The selected physical characteristics of the SST programed into the computer represent a delta-wing canard-type design. The horizontal airspace that is used depends greatly on the type of turn employed. Calculated values of aircraft deviation from course are shown, and the agreement with experimental values indicates that these deviations can be calculated with sufficient accuracy. IAA

N64-31143 Weather Bureau, Asheville, N.C. National Weather Records Center
CLIMATIC STUDIES FOR PROPOSED LANDING SYSTEM FOR CLEVELAND HOPKINS AIRPORT, CLEVELAND, OHIO Final Report
Atlantic City, FAA, Jun. 1964 82 p
(RD-64-54, Vol. 13)

This report consists of 32 volumes of climatological data for 32 different major airports. Ceiling, visibility, wind, and weather information is grouped seasonally and by various periods of the day. Various weather categories are tabulated, in most cases from 10 years of data, to act as an aid in making decisions affecting the landing systems at these 32 air terminals. Author

N64-31144 Weather Bureau, Asheville, N.C. National Weather Records Center
CLIMATIC STUDIES FOR PROPOSED LANDING SYSTEM FOR MUNICIPAL AIRPORT, ATLANTA, GEORGIA Final Report
Atlantic City, N.J., FAA, Jun. 1964 82 p For abstract see N64-31143 22-22
(RD-64-54, Vol. 14)

N64-31145 Weather Bureau, Asheville, N.C. National Weather Records Center
CLIMATIC STUDIES FOR PROPOSED LANDING SYSTEM FOR NEWARK AIRPORT, NEWARK, N.J. Final Report
Atlantic City, N.J., FAA, Jun. 1964 82 p For abstract see N64-31143 22-22
(RD-64-54, Vol. 15)

N64-31146 Weather Bureau, Asheville, N.C. National Weather Records Center
CLIMATIC STUDIES FOR PROPOSED LANDING SYSTEM FOR INTERNATIONAL AIRPORT, SAN FRANCISCO, CALIFORNIA Final Report
Atlantic City, N.J., FAA, Jun. 1964 82 p For abstract see N64-31143 22-22
(RD-64-54, Vol. 16)

N64-31147 Weather Bureau, Asheville, N.C. National Weather Records Center
CLIMATIC STUDIES FOR PROPOSED LANDING SYSTEM FOR GREATER SOUTHWEST INTERNATIONAL AIRPORT, FORT WORTH, TEXAS Final Report
Atlantic City, N.J., FAA, Jun. 1964 82 p For abstract see N64-31143 22-22
(RD-64-54, Vol. 17)

N64-31148 Weather Bureau, Asheville, N.C. National Weather Records Center
CLIMATIC STUDIES FOR PROPOSED LANDING SYSTEM FOR INTERNATIONAL AIRPORT, HOUSTON, TEXAS Final Report
Atlantic City, N.J., FAA, Jun. 1964 82 p For abstract see N64-31143 22-22
(RD-64-54, Vol. 18)

N64-31274 Emmanuel Coll., Boston, Mass. Research Language Center
A VERTICAL DIRECTION FINDING PROCEDURE [EIN VERTIKALPEILVERFAHREN]
W. Gerbes Bedford, Mass., AFCRL, Jun. 1963 54 p Transl. into ENGLISH of a Report of Flugfunk Forschungsinstitut (Oberpfaffenhofen, W. Germany)
(Contract AF 19(604)-8505)
(E-T-G-63-14; AD-420432)

The question of whether vertical direction finding is possible on the basis of an amplitude comparison of two fixed apparatus with different radiation patterns was examined. It was found that vertical direction finding on the basis of a field strength comparison is possible; this process is naturally free of bearing errors. There are other arrangements for which the field strength ratio assigned to a given angle of elevation is independent of the type (σ, ϵ) of the background, the essential condition for this being that the systems used for the comparison be symmetric to a single plane that is parallel to the earth's surface. For such systems the field strength ratio will also be independent of the azimuthal angle if rectangular, flat, perpendicular systems are used that are equal in width and have the same phase and current distributions. The most favorable systems are those made up of two horizontal dipoles connected in parallel, and those in which a dipole is located halfway between two others. The principle of the field strength comparison can be extended to horizontal direction finding. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-30248 Portugal. Nuclear Energy Commission, Scavem Lab. de Fisica e Engenharia Nucleares
RADIATION OF PURE WATER BY PROTON BEAMS FROM 1 TO 2 MeV. I: FIXED BEAM [RADIOLISE DA AGUA PURA POR PROTOES DE 1 A 2 MeV. I: FEIXE ESTACIONARIO]

Rui Namorado Rosa 1964 35 p refs In PORTUGUESE; ENGLISH summary
(LFEN.15 (α))

The experimental yields of H_2O_2 produced in pure aerated water by proton beams with energies from 1 to 2 Mev, and with dose-rates in the range of 10^{19} to 10^{23} ev/cm^3/s, were measured. Two theoretical models are proposed to describe the phenomenon and to interpret the experimental results. Comparing the theory with the experiment, conclusions were drawn concerning the radius of the distribution of transient species around the proton track in pure water, as well as their mean lifetime. Author

N64-30304 Chicago U., Ill. Lab. of Molecular Structure and Spectra
TECHNICAL REPORT 1962–1963, PART TWO
[1963] 326 p refs
(Contracts Nonr-2121(01); DA-11-022-ORD-3119; AF 19(604)-6662; AF 19(628)-2474; AF 33(657)-8891)
(AD-438424)

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10. A STUDY OF TWO-CENTER INTEGRALS USEFUL IN CALCULATIONS ON MOLECULAR STRUCTURE A. C. Wahl, P. E. Cade, and C. C. J. Roothaan p 148–193 refs (See N64-30314 22-23)

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12. ONE-CENTER-BASIS-SET SCF MO's. II: NH_3, NH_4^+, PH_3, PH_4^+ R. Moccia p 223–244 refs (See N64-30316 22-23)

13. ONE-CENTER-BASIS-SET SCF MO's. III: H_2O, H_2S, AND HCl R. Moccia p 245–257 refs (See N64-30317 22-23)

14. VECTOR COUPLING COEFFICIENTS FOR ATOMIC SELF-CONSISTENT FIELD CALCULATIONS G. L. Malli and J. P. Olive p 258–289 refs (See N64-30318 22-23)

15. ON THE RELATION BETWEEN ELECTRONS AND HOLES IN ATOMIC CONFIGURATIONS G. L. Malli p 290–294 refs (See N64-30319 22-23)

16. IRREDUCIBLE TENSOR EXPANSION OF SOLID SPHERICAL HARMONICS TYPE OPERATORS IN QUANTUM MECHANICS Y.-N. Chiu p 295–314 refs (See N64-30320 22-23)

N64-30305 Chicago U., Ill. Ryerson Lab.
RESONANT CHARGE EXCHANGE IN ATOMIC COLLISIONS
William Lichten *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 1–10 refs (See N64-30304 22-23) Repr. from Phys. Rev., v. 131, no. 1, 1 Jul. 1963 p 229–238
(Contract AF 19(604)-6662)

The remarkable results of Everhart et al. in observing resonant charge exchange in wide angle (small impact parameter) ion–atom collisions, are discussed in terms of the well-known impact parameter method. Previous theories based on adiabatic potential curves are inconsistent with the results of He^+—He experiments. However, experimental results are correctly predicted from a Heisenberg representation consisting of the basis set of single configuration wave functions built up from molecular orbitals (independent-particle model). This set includes virtual (autoionized) states. In this representation, the collision can be assumed to be adiabatic except for very short or very long collision times. The case of double charge exchange is treated, and it is shown that a three-state approximation is required. Author

N64-30306 Chicago U., Ill. Lab. of Molecular Structure and Spectra
THE ISOTOPE SHIFTS AND THE VIBRATIONAL STRUCTURE IN SOME WEAKER SYSTEMS OF N_2
D. Mahon-Smith (Natl. U. of Ireland, Dublin) and P. K. Carroll *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 11–26 refs (See N64-30304 22-23)

The emission spectrum of $N_2{}^{15}$ was studied in the region 2,000 to 9,000 A, in order to investigate the vibrational structure of some of the weaker systems. In the cases of the Herman infrared bands and the Gaydon–Herman green bands, it was possible to decide between the alternative vibrational schemes suggested. Observations were also made on the Goldstein–Kaplan and the $B' \rightarrow B$ systems. In the near-ultraviolet spectrum, it is shown that the $h \rightarrow a$, $s' \rightarrow a$, $r \rightarrow a$, $m \rightarrow a$, and $d \rightarrow a$ progression all arise from upper levels with $v > 0$. The possibility that some of these progressions may belong to a single system is discussed. The vibrational schemes for the fifth positive and Kaplan's first and second systems were confirmed. Some new bands of $N_2{}^{15}$, corresponding apparently to hitherto unobserved transitions, are reported. Author

N64-30307 Chicago U., Ill. Lab. of Molecular Structure and Spectra
A RECENT INVESTIGATION OF THE SPECTRUM OF THE He_2 MOLECULE
Marshall L. Ginter *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 27–29 refs (See N64-30304 22-23)
(Grant NsF GP-28)

A sufficient number of vibrational bands were obtained for the $c \rightarrow a$ transition to specify the molecular constants fairly well for both the c and a states. Also, the previously unreported $3p\sigma\ C^1\Sigma_g^+ \rightarrow 2s\sigma\ A^1\Sigma_u^+$ transition has been observed, and both the C and A states are characterized. The constants for these four states are listed in a table. Several other transitions were observed and are reported. D.E.W.

N64-30308 Chicago U., Ill. Lab. of Molecular Structure and Spectra

ACCURATE ANALYTICAL SELF-CONSISTENT FIELD FUNCTIONS FOR ATOMS. III: THE $1s^2 2s^m 2p^n$ STATES OF NITROGEN AND OXYGEN AND THEIR IONS

C. C. J. Roothaan and P. S. Kelly (Lockheed Missiles and Space Co., Palo Alto, Calif.) *In its* Tech Rept. 1962–1963, Pt. Two [1963] p 30–35 refs (See N64-30304 22-23) Repr. from Phys. Rev., v. 131, no. 3, 1 Aug. 1963 p 1177–1182

Self-consistent field functions have been determined in analytical form for all the neutral and positively ionized states and for some negatively ionized states of nitrogen and oxygen associated with the configurations $1s^2 2s^m 2p^n$, where $m, n \geq 0$. The functions determined differ from numerical Hartree–Fock functions by no more than a few units in the third decimal place, and usually by much less. Author

N64-30309 Chicago U., Ill. Lab. of Molecular Structure and Spectra

NONADIABATIC THEORY FOR DIATOMIC MOLECULES AND ITS APPLICATION TO THE HYDROGEN MOLECULE

W. Kolos and L. Wolniewicz (Nicolaus Copernicus U., Torun, Poland) *In its* Tech Rept. 1962–1963, Pt. Two [1963] p 36–46 refs (See N64-30304 22-23) Repr. from Rev. Modern Phys., v. 35, no. 3, Jul. 1963 Supported in part by NSF

Subjects discussed include the adiabatic approximation, the Schrödinger equation for the relative motion of the electrons and nuclei in a diatomic molecule, application to diatomic two-electron molecules, and the numerical results. D.E.W.

N64-30310 Chicago U., Ill. Lab. of Molecular Structure and Spectra

THE RYDBERG STATES OF MOLECULES, PARTS I-V

Robert S. Mulliken *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 47–84 refs (See N64-30304 22-23)

The Rydberg states of atoms are reviewed, and those of molecules, especially of homopolar diatomic molecules, are discussed. It is shown that the molecular orbitals of H_2^+ fall into good Rydberg series whose δ values change with R, and can be positive or negative depending on l and λ. It is shown that the nonpenetrating Rydberg molecular orbitals of homopolar diatomic molecules, in particular their term values, should conform to the "demi-H_2^+ model." The relations between Rydberg, valence-shell, and inner-shell molecular orbitals are discussed. Two sets of criteria for the bonding characteristics of diatomic molecular orbitals are briefly discussed. D.E.W.

N64-30311 Chicago U., Ill. Lab. of Molecular Structure and Spectra

ATOMIC SELF-CONSISTENT FIELD CALCULATIONS BY THE EXPANSION METHOD

C. C. J. Roothaan and P. S. Bagus (Lockheed Missiles and Space Co., Palo Alto, Calif.) *In its* Tech Rept. 1962–1963, Pt. Two [1963] p 85–108 refs (See N64-30304 22-23) Repr. from the book Methods in Computational Phys., v. II (New York), Academic, 1963 Supported in part by NSF

Subjects of discussion included are the general theory of the expansion method, the calculation of integrals, the calculation of eigenvectors and eigen values, self-consistent field iterations and extrapolations, convergence control, exponent variation, computer output format and options, computer input format and conventions, and limitations of the program. Sample printouts of parts of the input, of the output, and of various intermediate stages are included. D.E.W.

N64-30312 Chicago U., Ill. Lab. of Molecular Structure and Spectra

ACCURATE ANALYTICAL SELF-CONSISTENT FIELD FUNCTIONS. VI: THE GROUND STATES OF Mo^+ AND Mo

Clemens C. J. Roothaan and Miroslav Synek (De Paul U., Chicago) *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 109–116 refs (See N64-30304 22-23)

Self-consistent field calculations by the expansion method were carried out for the ground states of Mo^+ and Mo. Compared with solutions of the Hartree–Fock equations by the numerical integration technique, the wave functions obtained are accurate to 2 to 3 decimal places, and the total energies to about five significant figures. Author

N64-30314 Chicago U., Ill. Lab. of Molecular Structure and Spectra

A STUDY OF TWO-CENTER INTEGRALS USEFUL IN CALCULATIONS ON MOLECULAR STRUCTURE

Arnold C. Wahl, Paul E. Cade, and C. C. J. Roothaan *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 148–193 refs (See N64-30304 22-23)

(Grant NSF GP-28)

Certain electronic integrals were derived from problems of calculating the electronic energy, electric dipole and quadrupole moments, transition probabilities, fine and hyperfine coupling constants, and a number of other quantities. Methods are presented for computing these integrals that are thought to be near-optimal in reliability, automation, and accuracy. A significant aspect of these methods is that an approach was sought that would be unfailingly reliable and accurate regardless of the atomic orbitals involved in the integrals and, at the same time, would be as economical as possible. D.E.W.

N64-30315 Chicago U., Ill. Lab. of Molecular Structure and Spectra

ONE-CENTER-BASIS-SET SCF MO's. I: HF, CH_4, SiH_4

Roberto Moccia *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 194–222 refs (See N64-30304 22-23)

(Grant NSF G-9417)

One-center SCF MO ground-state wave functions are reported for HF, CH_4, and SiH_4. The molecular orbitals are expressed in terms of Slater-like functions all centered at a common origin. The basic sets employed contain more than twenty-five functions including, for the spherical harmonics, values of l up to three. The results of the calculations, performed by the use of a large electronic computer, refer to the geometrical configurations which, among many others considered, gave the minimum of the total energy. The equilibrium bond length determined for HF is 1.728 au, with a corresponding value of the energy of −100.0053 au and of the electric dipole moment of 2.104 debye. For CH_4 and SiH_4 the equilibrium configurations were found to possess tetrahedral symmetry with bond lengths of 2.08 and 2.787 au and energies of −39.86597 and −290.1024 au, respectively. The general features and capabilities of the one-center expansion approach to molecular systems are discussed. Author

N64-30316 Chicago U., Ill. Lab. of Molecular Structure and Spectra

ONE-CENTER-BASIS-SET SCF MO's. II: NH_3, NH_4^+, PH_3, PH_4^+

Roberto Moccia *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 223–244 refs (See N64-30304 22-23)

(Grant NSF G-4417)

One-center-expanded SCF MO wave functions are reported for the ground states of NH_3 and PH_3 in their planar and in

their calculated equilibrium configurations and of NH_4^+ and PH_4^+ in their calculated equilibrium configurations. The calculated molecular energies and the geometrical parameters of the determined equilibrium configurations agree well with the experimental values. Good agreement is also obtained for the electric dipole moment and the proton affinity of NH_3, while the calculated value of the height of the potential barrier for inversion appears to be too small. For PH_3 a good value for the height of the potential barrier is obtained, while the calculated electric dipole moment is too large. The calculated proton affinity of PH_3 seems to be reasonable. A critical examination of the wave functions gives an account of the quality of the several results obtained. Author

N64-30317 Chicago U., Ill. Lab. of Molecular Structure and Spectra
ONE-CENTER-BASIS-SET SCF MO's. III: H_2O, H_2S, AND HCl
Roberto Moccia *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 245–257 refs (See N64-30304 22-23)
(Grant NSF G-9417)

One-center expanded SCF MO wave functions are reported for H_2O, H_2S, and HCl in their ground states. The wave functions refer to the calculated equilibrium configurations, which agree well with the experimental. The corresponding computed molecular energies are -75.922436, -397.58906, and -458.83776 au, respectively, which are reasonably close to the experimental values. The energy obtained for H_2O is found to be near the estimated Hartree–Fock value. The computed electric dipole moment of H_2O agrees well with the experimental value, whereas for H_2S and HCl larger discrepancies are found. Author

N64-30318 Chicago U., Ill. Lab. of Molecular Structure and Spectra
VECTOR COUPLING COEFFICIENTS FOR ATOMIC SELF-CONSISTENT FIELD CALCULATIONS
Golzari L. Malli (Ph.D. Thesis, Pt. I) and Jospeh P. Olive *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 258–289 refs (See N64-30304 22-23)
(Grant NSF GP-28)

Equations are derived in a short discussion of self-consistent field calculations, and tables of coefficients calculated by computer are included. D.E.W.

N64-30319 Chicago U., Ill. Lab. of Molecular Structure and Spectra
ON THE RELATION BETWEEN ELECTRONS AND HOLES IN ATOMIC CONFIGURATIONS
Golzari L. Malli (Ph.D. Thesis, Pt. II) *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 290–294 refs (See N64-30304 22-23)
(Grant NSF GP-28)

Shortley has shown that the energy expression of a state of an atomic configuration involving holes differs from the configuration involving electrons by an array of coefficients, which are characteristic for this configuration. General formulas are given for these coefficients for atomic configurations consisting of any combination of s, p, and d shells, and for a single f shell. Author

N64-30320 Chicago U., Ill. Lab. of Molecular Structure and Spectra
IRREDUCIBLE TENSOR EXPANSION OF SOLID SPHERICAL HARMONICS TYPE OPERATORS IN QUANTUM MECHANICS
Ying-nan Chiu *In its* Tech. Rept. 1962–1963, Pt. Two [1963] p 295–314 refs (See N64-30304 22-23)
(Grant NSF GP-28)

A method is proposed for deriving the general one- and two-center expansions of quantum mechanical operators that are in the form of regular or irregular solid spherical harmonics of any integral degree. The expansions are expressed as couplings of irreducible spherical tensors. The physical nature of such coupling and the parallelism to vector additions are illustrated. Possible uses of such expansions in the evaluation of molecular integral and their reduction to simple, known expansions obtained from other methods are briefly discussed. Author

N64-30359 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE POSSIBILITY OF APPLICATION OF THE METHOD OF SCINTILLATIONS FOR REGISTRATION OF LOW-ENERGY IONS
A. B. Rastrepin and I. M. Zolototrubov *In its* Plasma Phys. and the Probl. of Controlled Thermonucl. Fusion 10 Jun. 1964 p 17–24 refs (See N64-30356 22-24)

The possible application of the scintillation method for detection of low ionic currents in energy band of ions of 1 to 20 kev is shown. With proper selection of the photomultiplier and without application of special measures for decreasing the dark current, this method makes it possible to measure ionic currents as low as 10^{-15} a. The lower limit of ion detection for current and energy is limited by the magnitude of the dark current of the photomultiplier. Decrease of the dark current of photomultipliers makes it possible to extend this method to the region of lower ion currents. The method allows the detection both of continuous currents and of separate ion clusters. Author

N64-30374 Los Alamos Scientific Lab., N. Mex.
THEORY OF GRAVITATION 1959–1963 Bibliography
Helen J. Chick 1 Sep. 1964 69 p refs
(Contract W-7405-ENG-36)
(LAMS-3099) OTS: $1.75

N64-30426 Joint Publications Research Service, Washington, D.C.
THE MECHANICS OF LOW-THRUST SPACE FLIGHT
G. L. Grodzovskiy, Yu. N. Ivanov, and V. V. Tokarev *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 74–134 refs (See N64-30416 22-33) OTS: $4.00

This work is devoted to a description of known analytic solutions of the equations of dynamics, exact and approximate, based on the smallness of perturbing forces, and to a description of numerical methods for constructing optimal trajectories and optimal directions. Author

N64-30459 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF ENERGY DISTRIBUTION OF PRODUCTS OF CATHODE SPUTTERING OF METALS BY MERCURY IONS
M. B. Ben'yaminovich and V. I. Veksler 21 Jul. 1964 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk UzSSR. Ser. Fiz.-Mat. Nauk (Tashkent), no. 3, 1963 p 29–36
(FTD-TT-64-542/1+2+4; AD-603061)

The spectral-energy distribution of sputtered mercury atoms was investigated for energies larger than or equal to 10 electron volts. An increased flow of sputtered particles and an increased degree of ionization were employed to produce detectable and measurable signals. The experimental apparatus is described in detail by diagrams. Equations are derived for the energy distribution of ions and of sputtered atoms. Numerical results are presented in tables and graphs, and are discussed at length. D.E.W.

N64-30481 Argentina. Comision Nacional de Energia Atomica, Buenos Aires

RELATION BETWEEN THE EFFECTIVE SECTIONS FOR THE ISOMERIC PAIR $Sc^{44m/44}$ FORMED IN THE NUCLEAR REACTION Sc^{43} (d,t) Sc^{44} [RELACION ENTRE LAS SECCIONES EFICACES PARA EL PAR ISOMERICO $Sc^{44m/144}$ FORMADO EN LA REACCION NUCLEAR Sc^{43} (D,T) Sc^{44}]

S. J. Nassiff, H. Vignau, M. C. Caracoche, and A. Mocoroa 1964 8 p refs In SPANISH *Its* Informe No. 108

The relation of effective sections between the isomers Sc^{44m} and Sc^{44} produced by the reaction (d,t) on Sc^{45} was determined. For the method of stacked metallic foils, the energy of deutrons was varied between 26.4 ±1.2 Mev and the threshold energy of the studied reaction. Trans. by D.E.W.

N64-30482 Argentina. Comision Nacional de Energia Atomica, Buenos Aires

RELATION OF EFFECTIVE SECTIONS FOR THE ISOMERIC PAIR $Co^{58m/58}$ OBTAINED BY THE REACTION (d,t) [RELACION DE SECCIONES EFICACES PARA EL PAR ISOMERICO $Co^{58m/58}$ OBTENIDO POR REACCION (d,t)

S. J. Nassiff, M. C. Caracoche, A. Mocoroa, and H. Vignau 1964 10 p refs In SPANISH *Its* Informe No. 109

The irradiation source, energies, and targets are described. The chemical separation method is outlined. Counting methods are described at length, and the disintegration scheme for ^{58}Co is given. The values of the ratio σ_m/σ_g were obtained as averages of three measurements carried out with different irradiation schemes. Values of the ratio obtained with different deuteron energies are given in a table and discussed. D.E.W.

N64-30486 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INVESTIGATION OF THE SECONDARY ION EMISSION DURING THE BOMBARDMENT OF METALS BY LOW-ENERGY IONS

D. D. Gruich, N. Rakhimbayeva et al 14 Jul. 1964 15 p refs Transl. into ENGLISH from Izv. Akad Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk (Tashkent), no. 1, 1964 p 53–60
(FTD-TT-64-544/1+2+4; AD-602878) OTS: $1.00

An investigation of the dependence of the coefficients [$K = f(E_0)$] of the secondary ion emission from the pure, cold targets of tungsten and molybdenum on the energy of the primary ions of Na^+, K^+, Rb^+, Cs^+, and Ba^+ is presented. The absolute values of the coefficients of K for Ba^+ ions in the whole region of E_0 under consideration were found to be more than two times the corresponding values for the alkali ions. The cause of this, apparently, is the large mass and ionization potential of Ba. P.V.E.

N64-30492 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)

ON THE COLLECTIVE VIBRATIONS OF A MANY-FERMION SYSTEM

B. Jancovici and D. H. Schiff Feb. 1964 14 p refs Sponsored by AF
(TH-42; AD-600266)

The energy levels of a many-fermion system are investigated through an extension of the generator coordinate method of Peierls–Yoccoz and Wheeler–Griffin. A trial wave function Y for the system is taken as a superposition $\psi = \int F(z)\,\Phi(z)\,dz$ of all possible independent particle wave functions Φ in the neighborhood of the Hartree–Fock ground state wave function Φ_0; the functions Φ depend on many parameters z. An integral equation is established for the generator function F(z). Through appropriate approximations, this integral equation is transformed into the Schrödinger equation for a set of coupled harmonic oscillators, and can be solved. The energies and wave functions are obtained for the ground state and the low excited states of the system. The approach is equivalent to the random-phase approximation. Author

N64-30510* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE CALCULATION OF PROTON PENETRATION AND DOSE RATES

Martin O. Burrell 17 Aug. 1964 77 p refs
(NASA-TM-X-53063) OTS: $3.00 fs; $0.75 mf

Computational methods are developed to determine the proton energy degradation and flux attenuation as a function of penetration depth in various materials. The primary purpose of this work is to estimate the energy deposition or tissue dose rate at a given depth or on the surface of a shielded object. Detailed analysis of the methods used and their accuracy are a prime part of this study. Numerous comparisons are made with results of other workers in this field. Author

N64-30541 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)

NON LOCAL QUANTUM ELECTRODYNAMICS

Maurice Levy Dec. 1963 53 p refs Sponsored by AF
(TH-38/11; AD-600265)

A gage invariant nonlocal form of quantum electrodynamics is constructed by introducing, in the interaction Lagrangian, averages of the Dirac field operators over time-like paths. It is shown that this theory leads to convergent results to every order of perturbation theory. Observable quantities are averaged subsequently over all possible time-like paths. The theory contains a finite renormalization of the photon mass and does not conflict with gage invariance. The experimental requirement that the physical mass of the photon should vanish corresponds to an additional condition to be imposed to the parameters on the theory. Author

N64-30543 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PROOF OF THE THEOREM OF A. N. KOLMOGOROV CONCERNING THE CONSERVATION OF CONDITIONALLY PERIODIC MOTIONS WITH SMALL CHANGE OF THE HAMILTONIAN FUNCTION

V. I. Arnol'd 7 May 1964 38 p refs Transl. into ENGLISH from USP. Mat. Nauk (Moscow), v. 18, no. 5(113), Sep.–Oct. 1963 p 13–40 refs
(FTD-MT-64-174; AD-600136)

The main ideas of A. N. Kolmogorov concerning the conservation of conditionally periodic motions with small change of the Hamiltonian function are presented. In the second section of the paper, formal formulations of the theorems and lemmas are presented. In the third section, proofs of the theorems and lemmas are given. P.V.E.

N64-30547 Catholic U. of America, Washington, D.C.
EXPERIMENTAL STUDY OF THE ABSORPTION IN DISTILLED WATER, ARTIFICIAL SEA WATER, AND HEAVY WATER IN THE VISIBLE REGION OF THE SPECTRUM Scientific Report No. 2
Seraphin A. Sullivan 1 Jun. 1964 9 p refs Repr. from J. Opt. Soc. Am., v. 53, no. 8, Aug. 1963 p 962–968
(Contract AF 19(604)-5558)
(AFCRL-64-559; AD-447205)

The absorption of light in distilled water, artificial sea water, and heavy water was measured in the visible region. A Nielsen spectrometer with glass optics was used with a tungsten source and photomultiplier detector. Path lengths were 60.0 and 132.0 cm. The absorption in distilled and in artificial sea water differs little; maxima below 745 mμ were too weak to be observed. The absorption in heavy water is very small, increasing from a broad minimum at 700 mμ to 600 mμ until at 390 mμ it is a factor of 10 larger than the minimum value. Author

N64-30558 Western Reserve U., Cleveland, Ohio
THEORY OF THE MANY-BODY BOSE SYSTEM Final Report, 16 Jun. 1959–30 Jun. 1963
P. R. Zilsel 15 Jan. 1964 11 p refs
(Contract DA-33-019-ORD-3003; Grant DA-ORD-40)
(AROD-2813-4; AD-602911)

The collective elementary excitations, as well as the ground-state properties, of the nonrelativistic many-body system of bosons interacting with short-range forces are being studied in an attempt to develop a theory of superfluid helium. The study is exploring the use of field theoretic representations, which include some collective many-body effects of the strong short-range interaction. P.V.E.

N64-30568 General Electric Co., Syracuse, N.Y. Military Communications Dept.
FEASIBILITY STUDY OF: STOCHASTIC MATRIX STORAGE AND PROCESSING USING THERMOPLASTIC AND OIL FILM TECHNIQUES Final Report
J. W. Brouillette and M. L. Noble Feb. 1964 47 p
(Contract AF 19(628)-2974)
(AFCRL-64-294; AD-600379)

This report describes an optical processing system that can perform matrix transformations of vectors of large dimensionality at exceedingly wide processing bandwidths by parallel analog techniques. Input vectors of wide bandwidth, up to 10 mc, are recorded as surface deformations on a thermoplastic film. A unique optical processing system, utilizing a photographic plate bearing the matrix, automatically performs the required matrix tranformation. The output vector is displayed on a cathode-ray tube and is additionally recorded on the thermoplastic film. This approach will potentially permit matrix transformations of vectors with 1,000 resolvable elements at rates from 1 to 10 per second, and perhaps higher. Author

N64-30617 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro
π^-p INTERACTIONS AT 4.0 GeV/c
L. Bondar, K. Bongartz, M. Deutschmann, E. Keppel, G. Kraus et al 1963 35 p refs *Its* Notas de Fisica, v. XI, no. 2

A bubble chamber investigation of π^-p interactions has been carried out at a momentum of 4 Gev/c. Analysis is limited to 3,828 events with two charged secondaries. Cross sections, angular distributions, and momentum distributions for the different reactions are presented. Four-momentum transfer distributions for elastic scattering and single-pion production are discussed. The production of pion resonant states is investigated. Author

N64-30618 California U., Santa Barbara
QUANTITATIVE STUDIES BY OPTICAL SPECTROSCOPY OF ENERGY EXCHANGE MECHANISMS IN SIMPLE GASES AND SOLIDS Technical Report, 1 Sep. 1963–30 Jun. 1964
H. P. Broida [1964] 34 p refs
(Contract Nonr-4222(01); ARPA Order-125)
(AD-442965)

These studies are separated into two parts: (1) the observed emission spectra in flowing gas streams in which the initiating energy source is an electrical discharge; and (2) the study of properties of liquid and crystalline rare gases as affected by temperature and the addition of small quantities of impurities. Author

N64-30637 Boeing Co., Seattle, Wash. Boeing Scientific Research Labs.
THE ELECTRONIC STRUCTURE OF $B_{10}H_{12}I_2$
Emmett B. Moore, Jr. Mar. 1964 38 p refs
(DI-82-0352; AD-602673) OTS: $3.00

Several molecular orbital calculations have been carried out for $B_{10}H_{12}I_2$. The first two allowed electronic transitions are found to be polarized perpendicular to the twofold axis of the molecule, which is in agreement with experiment. The ionization energy is predicted to be 0.5 to 1.0 ev less than the ionization energy of $B_{10}H_{14}$, and the dipole moment is predicted to be 0.5 to 1.0 D greater than the dipole moment of $B_{10}H_{14}$. The charge distribution is predicted to be the same as in $B_{10}H_{14}$ with the exception of boron atoms 2 and 4 from which negative charge is abstracted by the iodine atoms. Author

N64-30662 Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro
THE Li^6 (p, α) He^3 REACTION
J. M. F. Jeronymo, G. S. Mani, and A. Sadeghi (Centre d'Etudes Nucleaires) 1963 15 p refs *Its* Notas de Fisica v. X, no. 20

The Li^6(p, α)He^3 reaction has been studied up to 5 Mev proton energy. The excitation curve and angular distributions were measured from 2.0 to 5.0 Mev proton energy in steps of about 100 kev. The possible existence of a positive parity state of Be^7 around 4.0 Mev proton energy is indicated. Author

N64-30666 New Mexico State U., University Park
ANISOTROPIC LIGHT SCATTERING BY INNER FIELD FLUCTUATIONS IN A DENSE MONATOMIC GAS
O. Theimer and R. Paul [1963] 29 p refs Supported in part by Navy Dept.
(AD-602919) OTS: $2.00

The intensity of light scattering by monatomic gases is calculated by a new method that is particularly suited to analyzing the effect of collective phenomena such as the fluctuations of the inner field. The Fourier coefficients of the polarizability density are used as stochastic variables, and their relation to the atomic form factor and the particle density is established. The effective inner field for a specific particle configuration is obtained as an iterative solution of an integro-differential equation and is used for calculating the scattering intensity. This intensity is then averaged over all particle configurations. At ordinary pressures ($\alpha n << 1$, α is atomic polarizability, n is

the particle density) Rayleigh's scattering formula is confirmed, but at high pressure ($\alpha n \rightarrow 1$) observable corrections to his formula are obtained. Author

N64-30673 Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
SCINTILLATION SPECTROMETRY. GAMMA-RAY SPECTRUM CATALOGUE, VOLUME I OF 2
R. L. Heath Aug. 1964 276 p refs 2d ed.
(Contract AT(10-1)-205)
(IDO-16880-1) OTS: $10.00

A new edition of the Scintillation Spectrometry Gamma-ray Spectrum Catalogue has been issued. As in the original, this edition contains a collection of spectra respresenting the response of a scintillation spectrometer to individual radioactive nuclides. All spectra are normalized to a standard set of gain scales, and a text is presented that describes the fundamentals of gamma-ray spectrometry. This includes a discussion of spectrometer design, electronics, instrumental calibration, and data processing. To facilitate the use of these data, tables of detector efficiency, photopeak efficiency, and other information useful for quantitative data analysis have been included. An extensive index has also been added with separate tables of data listed according to gamma-ray energy, half-life, method of source production, and other specialized categories. Author

N64-30674 Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
SCINTILLATION SPECTROMETRY. GAMMA-RAY SPECTRUM CATALOGUE, VOLUME 2 OF 2
R. L. Heath Aug. 1964 268 p 2d ed. For Abstract See N64-30673 22-23
(Contract AT(10-1)-205)
(IDO-16880-2) OTS: $10.00

N64-30683 Technical Operations Research, Burlington, Mass.
TRANSMISSION OF GAMMA RADIATION THROUGH THIN, FINITE SLABS Summary of Research Report
M. J. Barrett, William E. Barch, and Robert L. Mac Neil May 1964 6 p
(Contract OCD-OS-62-14)
(AD-603413)

Based on an analysis of the results, a good approximation to the dose buildup factor for thin shields is $B = 1 + \lambda\omega^{2/3}$ for photon energies in the range 0.6 to 1.3 Mev, and perhaps higher, with the photons incident normally on a flat shield, of a thickness equivalent to λ mean free paths, where λ is less than 3, and subtending a solid angle $2\pi\omega$ at the dose detector. This empirical result was related to the intensity of scattered radiation in the transmitted beam. Author

N64-30684 Technical Operations Research, Burlington, Mass.
TRANSMISSION OF GAMMA RADIATION THROUGH THIN, FINITE SLABS
Mathew J. Barret, William E. Barch, and Robert L. Mac Neil May 1964 41 p refs
(Contract OCD-OS-62-14)
(TO-B-64-44; AD-603414) OTS: $2.00

The shielding of gamma radiation, at photon energies where the Compton scatter process is dominant, results in a transmitted beam that is largely composed of scattered photons. An approximate formula has been developed through experiment to calculate the scattered radiation and, therefore, to determine the exact transmission, i.e., dose buildup factor (B), for thin shields in the range of photon energies from 0.6 to 2 Mev. The results of this experiment also give rise to a simple method of measuring any microscopic scattering cross section by an array of detectors without loss of the definition of the scattering angle. Author

N64-30699 California U., Berkeley Inst. of Engineering Research
ON THE DERIVATION OF DISCONTINUITY CONDITIONS IN CONTINUUM MECHANICS
A. E. Green and P. M. Naghdi Jul. 1964 12 p refs
(Contract Nonr-222(69))
(AM-64-11; AD-603936)

The usual discontinuity conditions at a surface of discontinuity in classical continuum mechanics are derived from an equation of energy and from the use of invariance conditions under superposed rigid-body motions. The modifications required when director and dipolar displacement fields are present are also indicated. Author

N64-30738 Rhode Island U., Kingston Div. of Engineering Research and Development
SURFACE WAVES IN A FLUID-SOLID INTERFACE NEAR A DISCONTINUITY
T. Y. Yip and F. H. Middleton 1 May 1964 42 p refs
(Contract Nonr-396(12))
(TR-5; AD-602723) OTS: $2.00

This study is concerned with surface waves that propagate along an interface between a fluid and an elastic solid. In particular, interesting transmission and radiation behavior is caused by a wedge-shaped discontinuity in the interface. An iteration procedure is employed by which the boundary conditions on either face of the wedge are alternately satisfied. Using only the first iteration produces a transmission coefficient. Numerical data are presented showing the manner in which the transmission coefficient depends upon the angle of the discontinuity. Results are compared with those of related studies appearing in the recent literature. Author

N64-30745 Tracerlab, Inc., Waltham, Mass.
USE OF RADIOISOTOPES AS A SOURCE OF X-RAYS TO DEVELOP A RAYLEIGH SCATTERING METHOD FOR THE ANALYSIS OF HIGH Z ATOMS IN A LOW Z MEDIA Final Report
Joris M. Brinkerhoff Jul. 1963 29 p refs
(Contract AT(30-1)-2533)
(TID-20643) OTS: $0.75

The measurement of uranium content of aluminum-clad uranium–aluminum fuel plates was undertaken. The principle of operation rested upon the enhanced Rayleigh scattering of X-radiation by high atomic numbers. The determination of the concentration of uranium in uranium–aluminum ingots was also undertaken. Two radiation detectors were constructed. A Rayleigh scattering-gage response curve of the uranium concentration is shown. Results are given of comparison of measurements by the instrument with those obtained by chemical assay. A.W.

N64-30762 Baird-Atomic Inc., Cambridge, Mass.
EFFECT OF OPTICAL PATH IMPERFECTIONS ON FABRY-PEROT MODULATOR PERFORMANCE Technical Documentary Report, 17 Feb.–17 Jul. 1964

Vincent DelPiano, Jr. Wright-Patterson AFB, Ohio, AF Avionics Lab. [1964] 61 p refs
(Contract AF 33(615)-1254)
(AL-TDR-64-141; AD-603004)

Previously, a theoretical investigation was conducted on the effects of variation in optical pathlength upon the performance of a Fabry–Perot-type wideband modulator. The variations consisted of statistical distributions within or across the aperture, and two probability distributions of the variable pathlength were studied: a rectangular and a gaussian. The objective of the present work was to provide direct experimental verification of the theoretical results of the probability study as well as to characterize and access the present performance of the modulator in order to provide guidance for future work. Author

N64-30920 Joint Publications Research Service, Washington, D.C.
METROLOGY IN RADIO ENGINEERING
G. Paliy 18 Sep. 1964 12 p Transl. into ENGLISH from Radio (Moscow), no. 7, 1964 p 50–53
(JPRS-26461; TT-64-41719) OTS: $1.00

A general discussion concerning the establishment of international units is presented. The methods of making the basic types of measurements on radio equipment (currents, voltages, inductances, etc.) are outlined, and the accuracy of these measurements is discussed. P.V.E.

N64-30924 Texas Nuclear Corp., Austin
COMPILATION OF NEUTRON REACTION AND TOTAL CROSS SECTIONS AT 14 MEV Technical Documentary Report, Jan. 1, 1963–Jan. 31, 1964
Suresh C. Mathur, John B. Ashe, and Ira L. Morgan Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1964 76 p refs
(Contract AF 33(616)-8160)
(ASD-TDR-62-1038, Pt. III, Vol. II; AD-601558)

A list of cross-section data and related information has been compiled for total neutron cross sections and the reaction cross sections (n,p), (n,α), and (n,2n) in the energy region around 14 MeV. A gamma-ray spectral atlas containing 54 sets of spectra of some of the more common elements in the periodic table was obtained by activation analysis with 14.8 MeV neutrons. A 1- and a 5-minute irradiation of each element was made, and spectra were recorded at various times after irradiation to emphasize decay characteristics of the radioactive products from the irradiated element. Gamma-ray peaks from the reaction products were identified, as well as radioactive decay products from trace impurities in each element, whenever possible. Carbon and nitrogen surface contamination of several high-purity beryllium samples were measured by proton irradiation. Author

N64-30937 Technical Operations Research, Burlington, Mass.
INVESTIGATION OF COHERENT OPTICAL PROPAGATION Final Report
T. J. Skinner and R. E. Whitney Griffiss AFB, N.Y., RADC, Aug. 1964 77 p refs
(Contract AF 30(602)-2619)
(RADC-TDR-64-65; AD-605319)

This report discusses the guided propagation of an optical signal. The beam waveguide has been chosen for consideration because of its extremely low intrinsic loss. These intrinsic losses, along with misalignment and feed losses, are derived. The misalignment losses are high. To reduce them, a flexible joint has been designed that allows the guide to flex without introducing prohibitive losses. The feasibility of the beam waveguide is demonstrated. Author

N64-30949 Israel Inst. of Technology, Haifa
MATRIX ELEMENTS FOR POLARIZED FERMION SCATTERING Scientific Report No. 1
Micha Hofri and Asher Peres Wright-Patterson AFB, Ohio, ARL, 2 Apr. 1964 16 p refs
(Grant AF-EOAR-64-20)
(ARL-64-162; AD-605492)

Explicit formulas are given for matrix elements of the type $v^{+}(\vec{p})\gamma^{\alpha}\gamma^{\beta}...\gamma^{\delta}v(\vec{q})$, where $v(\vec{p})$ and $v(\vec{q})$ are normalized Dirac eigenspinors, the spins of which are defined by the projections of the Foldy–Wouthuysen mean spin operator on arbitrary axes. Author

N64-30950 Israel Inst. of Technology, Haifa
ANOMALOUS SPINOR EQUATIONS Scientific Report No. 2
A. Peres Wright-Patterson AFB, Ohio, ARL, 14 Apr. 1964 8 p refs
(Grant AF-EOAR-64-20)
(ARL-64-163; AD-605493)

Two-component anomalous spinor equations, describing particles of nonvanishing mass, are derived from a generally covariant Lagrangian principle. Some properties of the solutions are discussed, and some difficulties are pointed out. Author

N64-30951 Israel Inst. of Technology, Haifa
CONSTANCY OF e^2/hc IN A GRAVITATIONAL FIELD Scientific Report No. 3
A. Peres Wright-Patterson AFB, Ohio, ARL, 26 Apr. 1964 7 p refs
(Grant AF-EOAR-64-20)
(ARL-64-164; AD-605474)

It is shown that if the fine structure constant depends on the gravitational potential V as $(1 + kV/c^2)$, then the experimental limit on k is at most 10^{-8}. Similar results hold for the proton–electron mass ratio and many other dimensionless physical constants. Author

N64-30952 Israel Inst. of Technology, Haifa
COMMUTATION RELATIONS FOR ENERGY-MOMENTUM TENSOR Scientific Report No. 4
A. Peres Wright-Patterson AFB, Ohio, ARL, 26 Apr. 1964 6 p refs
(Grant AF-EOAR-64-20)
(ARL-64-165; AD-605494)

It is shown that Schwinger's formula for $[T^{00}(x), T^{00}(y)]$ cannot be generalized, in a covariant fashion, to the other components of the energy-momentum tensor. Author

N64-30953 Israel Inst. of Technology, Haifa
COMMUTATION RELATIONS FOR ELECTROMAGNETIC POTENTIALS Scientific Report No. 5
A. Peres Wright-Patterson AFB, Ohio, ARL, 26 Apr. 1964 9 p refs
(Grant AF-EOAR-64-20)
(ARL-64-166; AD-605495)

Given the known (gage-independent) value of $[F_{ab}(x), F_{cd}(y)]$, the most general expression is derived for the commutator $[A_a(X), A_b(y)]$. The latter contains four arbitrary functions $N_a(x, y)$, which, if suitably chosen, may yield the Coulomb gage, the Feynman gage, the Landau gage, etc. It is, however, impossible to go over from one value of $N_a(x,y)$ to another by means of an operator gage transformation, unless the difference between both values of N satifies some differntial relations. Author

N64-30954 Israel Inst. of Technology, Haifa
MACROSCOPIC BODIES IN QUANTUM THEORY Scientific Report No. 7
A. Peres and N. Rosen Wright-Patterson AFB, Ohio, ARL, 7 May 1964 12 p refs
(Grant AF-EOAR-64-20)
(ARL-64-168; AD-605531)

If the wave function of a massive body is $u=c_nu_n$, where the u_n are macroscopically distinguishable states, then the observation of interferences between the various u_n requires inconceivable laboratory conditions (e. g., the experiment may last longer than the lifetime of the universe). It is therefore proposed to interpret c_nu_n as a mixture of states, and not as a superposition. This new interpretation of wave functions is consistent with experience and is free from the paradoxical features of the "orthodox" measurement theory. Author

N64-30955 Israel Inst. of Technology, Haifa
INEQUIVALENCE THEOREM IN QUANTUM FIELD THEORY Scientific Report No. 8
A. Peres Wright-Patterson AFB, Ohio, ARL, 23 Jun. 1964 11 p refs
(Grant AF-EOAR-64-20)
(ARL-64-169; AD-605475)

Lagrangians that differ by a four-divergence may lead to physically inequivalent theories. For instance, it is shown that the interaction $J^m(x)A_{,m}(x)$ gives nonvanishing fourth-order Feynman diagrams. This fact has several important consequences. In particular, the various photon propagators that differ by terms of the type $k_ak_bf(k^2)$ are physically inequivalent. Author

N64-30984 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
TRIPLET-TRIPLET ABSORPTION IN SENSITIZED SOLVENT DECOMPOSITION
S. Siegel and R. Eisenthal 22 May 1964 74 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-97; TDR-269(4240-30)-7; AD-605613)

The decay of the steady-state EPR signal from naphthalene triplet-state molecules in ether and other gases under continuous near-ultraviolet irradiation at 77° K has been examined in some detail. Free radicals are produced by sensitized solvent decomposition at the same rate as the disappearance of the triplet-state EPR signal. The latter decay process has a first-order dependence upon naphthalene concentration, and it exhibits a dependence upon excitation intensity, which is consistent with a two-photon absorption mechanism. The experimental results are discussed in terms of a model that involves the resonant transfer of energy from a highly excited triplet state of naphthalene to the solvent. Excitation of the excited triplet state takes place via the absorption of a photon by a naphthalene molecule in its lowest triplet state. The free radicals are produced by the decomposition of the sensitized solvent molecule. Author

N64-31016 National Lead Co. of Ohio, Cincinnati Feed Materials Production Center
THE CORRECTION FOR FLUORESCENCE BY CHARACTERISTIC RADIATION IN MICROPROBE ANALYSIS
J. W. Colby 8 Oct. 1964 31 p refs
(Contract AT(30-1)-1156)
(NLCO-917) OTS: $2.00

Suggested values are given for the fluorescence yields and the absorption jump ratios. The correction for fluorescence by characteristic radiation has been tabulated, thus simplifying the overall calculation of the correction. Author

N64-31024 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
PROCEEDINGS OF THE TASHKENT CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, VOLUME II
R. I. Khamidov, ed. Jul. 1964 604 p refs Transl. into ENGLISH of the book "Trudy Tashkentskoi Konferentsii po Mirnomu Ispol'zovaniyu Atomnoi Energii, Tom II" Tashkent, Izd. Akad. Nauk Uzbek. SSR,
(AEC-TR-6390) OTS: $7.00

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71. DOUBLE BONDS IN POLYETHYLENE IRRADIATED BY FAST ELECTRONS N. A. Sloovkhotova, A. T. Koritskii, and N. Ya. Buben p 571–573

72. INVESTIGATION OF FREE RADICAL REACTIONS IN IRRADIATED TEFLON Yu. D. Tsvetkov, Ya. S. Lebedev, and V. V. Voevodskii p 574–585 refs

73. DEUTEROEXCHANGE ON SOLID SURFACES IN THE GASEOUS PHASE S. V. Markevich and A. A. Ivko p 586–593 refs

N64-31030 Brown U., Providence, R.I. Engineering Div.
MEASUREMENTS OF THE ATTENUATION OF SOUND BY SUSPENDED PARTICLES
R. A. Dobbins and S. Temkin Mar. 1964 47 p refs Prepared for Allegany Ballistics Lab., Hercules Powder Co.
(Contract NOrd-16640)
(ABL/X115; AD-602245) OTS: $2.00

The work is an experimental study of the attenuation of acoustic waves by suspended particles, with emphasis on the dimensionless size range of greatest interest in the study of rocket instability. An aerosol composed of oleic acid particles of controlled size and concentration is produced in a La Mer generator. Attenuation of sound by the aerosol is measured by means of an acoustic impedance tube similar to those used to measure properties of acoustic insulating materials. Mean particle size and concentration are measured by transmission and sampling tests of the aerosol in situ. Results of measurements made to date indicate fair agreement with theory and show that the efficiency of the particles as acoustic attenuators decreases at small dimensionless sizes. Author

N64-31032 Portugal Nuclear Energy Commission, Sacavem. Lab. de Fisica e Engenharia Nucleares
X-RAYS PRODUCED BY BREMSSTRAHLUNG ON A THICK TARGET WITH 1.2 MEV ELECTRONS. DETERMINATION OF THE INTENSITY DISTRIBUTION AROUND THE VAN DE GRAAFF MACHINE OF THE L.F.E.N. [RAIOS X PRODUZIDOS POR EFEITO DE BREMSSTRAHLUNG NUM ALVO ESPESSO COM ELECTROES DE I A 2 MEV. DETERMINACAO DA DISTRIBUICAO DA INTENSIDADE EM TORNO DO ACELERADOR VAN DE GRAAFF DO L.F.E.N.]
Maria Do Carmo Anta, Manuel Jose De Campos Costa, Rui Namorado Rosa, Candido Marciano Da Silva, and Horacio Maggiolli Novals 1963 48 p refs In ENGLISH and PORTUGUESE
(LFEN.7 (γ, δ))

The intensity distribution of the X-radiation field around the Van de Graaff machine, when electrons accelerated to energies between 1 and 2 MeV are incident on a thick gold target, was measured by means of the Fricke dosimeter. On the basis of these measurements, constant intensity curves in the target room were determined; as a function of the initial energy of the electrons, the fraction of this energy, which is transformed into radiant energy available in the room, was calculated, as well as the intensity of the bremsstrahlung produced in the target in the direction of the incident electron beam, $I_{(\theta = 0)}$ (Au). The results lead to an empirical law for the intensity of the bremsstrahlung transmitted at zero degrees. This law is in accordance with Kramer's theoretical formula. Author

N64-31047 Franklin Systems, Inc., West Palm Beach, Fla.
INVESTIGATION, CONCEPTUAL DESIGN AND OPERATIONAL USE OF A DIRECTIONAL NUCLEAR RADIATION DETECTOR Final Report
Kirtland AFB, N. Mex., AF Spec. Weapons Center, Apr. 1963 67 p
(Contract AF 29(601)-5405)
(AFSWC-TDR-63-28; AD-405159)

Several ground-based systems have been shown to be feasible for defining the location, curie strength, and energy level of numerous and powerful radioactive, gamma-emitting sources scattered across an area of 1,000-ft radius. These systems involve use of fixed survey sites, or mobile sites, or a combination thereof, the preferred system using two fixed

and one mobile. Primary study considerations have involved accuracy of source location, radiation hazards to crew personnel, optimum means of source collimation, flexibility to adapt to various problem situations, and adaptability to use of certain second- and third-generation aids involving airborne facilities and superimposed visual displays. Author

N64-31058 Stanford U., Calif. Stanford Linear Accelerator Center
1963 SUMMER STUDY REPORT, PART TWO
L. Hand and R. Wilson (Harvard U.) [1963] 73 p refs
(Contracts AT(04-3)-400; AT(04-3)-476)
(SLAC-25, pt. 2) OTS: $1.50

Two papers are presented. The first paper "Inelastic Electron–Proton, Positron–Proton, and Muon–Proton Scattering", includes a discussion of an equivalent radiator for electrons, polarization of virtual photons, and classes of experiments involving inelastic electron scattering. The second paper, "Electroproduction at SLAC," considers the use of electrons inelastically scattered at very small angles as a source of monochromatic virtual gamma rays. P.V.E.

N64-31062 Phillips Petroleum Co., Idaho Falls, Idaho National Reactor Testing Station
MULTIGROUP ONE-DIMENSIONAL SPHERICAL HARMONIC SOLUTIONS TO THE BOLTZMANN TRANSPORT EQUATION
D. R. Metcalf Jun. 1964 58 p refs
(Contract AT(10-1)-205)
(IDO-16998) OTS: $1.25

Useful multigroup equations are derived for calculating the isotropic flux in a slab or cylindrical reactor cell. Full details are given of the reduction of the Boltzmann transport equation to spherical harmonic theory including putting the slowing down differential scattering cross section in a form suitable for calculation purposes. Author

N64-31076 Air Force Systems Command, Edwards AFB, Calif. Rocket Propulsion Lab.
EXTREME ULTRA-VIOLET EXCITATION OF HELIUM
V. D. Calbi, G. R. Orme, and A. S. Hawes, comp. Jun. 1964 23 p refs
(RPL-TDR-64-96; AD-448082)

Determinations of metastable helium atom concentrations indicate the existence of an upper limit, the value of which differs for different sets of conditions. The possibility of achieving a controlled excitation by exposing helium to extreme ultraviolet radiation is examined, in an attempt to optimize metastable atom formation. The exposure of helium to 584Å radiation produced the 2^1S state, which was detected spectro photometrically. Author

N64-31089 Raytheon Co., Waltham, Mass. Research Div.
FULL WAVE TREATMENT OF PROPAGATION OF SOUND IN A MEDIUM OF CONSTANT VELOCITY GRADIENT Scientific Report No. 2
J. D. Cornwell and B. S. Tanenbaum Aug. 1963 42 p refs
(Contract AF 19(628)-2802)
(S-583; AFCRL-63-751; AD-440769)

This report deals with the solution to the wave equation for an acoustic point source in a medium where the velocity of sound changes with altitude. In the simplest case, when the velocity of sound increases linearly with altitude, a complete expression for the sound field is obtained both for the steady-state and for the transient problems. The simple analytic expressions obtained in this case for the amplitude of the waves and the transit time for the signal to travel from the source to the receiver are shown to be both more accurate and simpler to apply than the customary ray theory results. A formal solution to the wave equation is also obtained for the case when the velocity profile consists of two linear segments. While the resulting exact expressions are too complicated to be of great practical use, they do lead to a simple technique for calculating the transit time in the ray theory limit. Author

N64-31102 Naval Ordnance Lab., White Oak, Md.
POLARIZATION OF PROTONS FROM THE $B^{10}(He^3,p)C^{12*}$ (4.43 MeV) REACTION
Donald G. Simons Aug. 1964 141 p refs
(NOLTR-64-113; AD-447571)

Proton polarizations were measured for the $B^{10}(He^3,p)C^{12*}$ (4.43 MeV) reaction at He^3 energies of 2.5 and 2.8 MeV. These measurements were made for twelve angles from 0° to 135° at 2.5 MeV, and for six angles from 15° to 75° at 2.8 MeV. The measurements at 2.5 MeV show that the polarization reaches a minimum of $-0.36 \pm .07$ at $\theta_{lab} = 15°$ where the sign of the polarization follows the Basel convention. At larger angles the polarization fluctuates and generally decreases. It was not determined whether the polarization changes sign or is zero at the back angles. The angular dependence of the polarizations at 2.8 MeV are similar to those obtained at 2.5 MeV indicating a weak energy dependence in the energy range used. Author

N64-31132 General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
THE CALCULATION OF PHOTO IONIZATION CROSS SECTIONS BY THE QUANTUM DEFECTS METHOD
Earl Peterson Apr. 1964 56 p refs
(Contract DA-04-495-ORD-3567(Z); ARPA Order 357-63; Proj. Defender)
(TR-64-02B; AD-446282)

The quantum-defect method of calculating cross sections of the photoionization radiative process involves an asymptotic approximation to the radial part of both the bound and free one-electron wave functions. This report sketches the theory and describes application of the method to nitrogen and oxygen atoms and first ions of oxygen and nitrogen. The computer program that performs the calculations is described, and the resulting cross sections are fit by least squares to a simple power-law function of frequency, a form convenient for use in calculating radiation from nonequilibrium flow fields. Author

N64-31157 Oxford U. (Gt. Brit.) Clarendon Lab.
NUCLEAR RESONANCE IN LIQUID AND SOLID He^3 AT LOW TEMPERATURES Final Technical Status Report No. 2, 1 Dec. 1961–30 Nov. 1962
J. Hattan and D. F. Brewer [1962] 16 p refs
(Contract DA-91-591-EUC-2035)
(AD-420098)

Measurements are given on the susceptibility and spin-lattice relaxation time of liquid He^3 in the temperature range 1° to 3° K at pressures up to 34 atm. The susceptibility measurements show that the nuclear magnetic susceptibility of the liquid falls more rapidly than 1/T as the temperature is reduced below about 1.8° K, although the deviation from this classically expected behavior amounts to only about 4% at 1° K. The

pressure dependence of the susceptibility is very small. Between 1° K and 3° K, no change of molar susceptibility as great as 1% could be detected when the molar volume was changed by 40% by the application of pressure. Author

N64-31158 General Electric Co., Philadelphia, Pa. Missile and Space Div.
APPLICATION OF NUCLEAR RESONANCE SENSING TO MEASUREMENT OF MECHANICAL MOTION
R. Zito, Jr. 14 Oct. 1963 49 p refs
(R63SD317; AD-420334)

This report describes an approach to the design of a device employing nuclear radiation sources (radio-isotopes) in conjunction with suitable detectors to provide precise mechanical position and velocity measurements. The Mössbauer effect is utilized via a resonant gamma-ray detector for the quantitative sensing of relative motion. Author

N64-31170 Emmanuel Coll., Boston, Mass. Research Language Center
THE FREQUENCY RESPONSE FUNCTION IN A COHERENT OPTICAL SYSTEM AND ITS FREQUENCY SELECTION CHARACTERISTICS IN TRANSMITTING OPTICAL INFORMATION
Tan Wei-Han Bedford, Mass., AFCRL, May 1963 17 p refs
Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 16, no. 6, 1960 p 316–323
(Contract AF-19(604)-8505)
(E-T-Ch-63-4; AD-420430)

A one-dimensional case, which is easy to generalize into a two-dimensional case, is considered. The transition of a response function is pointed out in a general case to one in an incoherent case, i.e., one used generally to discuss the image formed. The physical significance of zero-order energy is also emphasized. A.W.

N64-31176 RAND Corp., Santa Monica, Calif.
A SPECTRAL ANALYSIS OF THE ANISOTROPIC NEUTRON TRANSPORT KERNEL IN SLAB GEOMETRY WITH APPLICATIONS
A. Leonard and T. W. Mullikin Oct. 1963 49 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3807-PR; AD-421060)

This memorandum applies the theory of singular integral equations and analytic continuation to the study of neutron transport with anisotropic scattering. A spectral analysis for the transport kernel in plane geometry is achieved that immediately leads to the determination of critical thickness and the time-dependent behavior of nuclear reactors under the assumption of homogeneity and constancy of neutron energy. Author

N64-31186 Martin Co., Baltimore, Md. RIAS Div.
STUDY OF SOLUTION OF STABILITY PROBLEMS OF NONLINEAR SYSTEMS Final Summary Report, 27 Jun. 1961–27 Jun. 1963
S. Lefschetz and J. P. La Salle [1963] 13 p refs
(Contract DA-36-034-ORD-3514-Z)
(AD-422279)

The major contributions are in the following areas: (1) stability of dynamical systems; (2) nonlinear oscillations; and (3) functional-differential equations. A brief description is given of the types of problems of interest. A summary of the work completed and a brief statement of some of the principal results are presented. References to complete reports on the research are given. Author

N64-31206* California U., Berkeley
THE THREE BODY PROBLEM
C. G. Lemaitre Washington, NASA, Oct. 1964 49 p
(Grants NsG-243-62; NsG-122-61)
(NASA-CR-110) OTS: $1.25

Relative axes are introduced, which are the principal axes of inertia of the system of the three masses. They are related to a fixed axis by Euler's angles ϕ, ψ, θ in the customary manner. The cartesian coordinates of the masses relative to the principal axes are defined by way of the three coordinates r, B, L, which are related in a simple way to the three distances r_1, r_2, r_3 of the masses. These formulas involve the three angles μ_1, μ_2, μ_3, depending on the masses. They are the angles of the triangle of the masses in the particular configuration for which the ellipse of inertia is a circle. The elimination of the nodes is made in the usual way by elimination of the Eulerian angle θ, and the Hamiltonian is obtained. The relation of these coordinates with a variable introduced by Lagrange is shown, leading to simplification in the work of Lagrange. Author

N64-31223* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF ACOUSTIC THEORY TO PREDICTION OF SONIC-BOOM GROUND PATTERNS FROM MANEUVERING AIRCRAFT
Donald L. Lansing Washington, NASA, Oct. 1964 31 p refs
(NASA-TN-D-1860) OTS: $0.75

The acoustic theory of the propagation of weak disturbances through an atmosphere having a linearly decreasing sound speed is applied to the problem of determining the location of the shock wave produced by a maneuvering aircraft. A graphical procedure involving ray tracing and an analytical procedure based on the ballistic wave are discussed. Some examples are given that show the effects typical flight maneuvers may have upon the ground shock pattern. Author

N64-31244 Illinois U., Urbana Coordinated Science Lab.
PROGRESS REPORT FOR JUNE, JULY, AUGUST, 1963
25 Sep. 1963 60 p refs
(Contract DA-36-039-AMC-02208(E))
(AD-420532)

Progress in research dealing with the following is summarized: (1) "Electric Vacuum Gyroscope"; (2) "Surface and Atomic Physics"; (3) "Computer" (operation statistics); (4) "System Theory" (programs for self diagnosis, communication network synthesis, etc.); (5) "PLATO" ("inquiry teaching logic"); (6) "Vacuum Instrumentation"; (7) "Plasma Physics"; (8) "High Magnetic Field Semiconductors"; (9) "Vacuum Electrical Breakdown"; and (10) "Evaporated Thin Films." P.V.E.

N64-31251 Technical Operations Research, Burlington, Mass.
MONTE CARLO CODES TO INVESTIGATE THE REFLECTION AND TRANSMISSION OF GAMMA RAYS AND NEUTRONS IN HOMOGENEOUS AND HETEROGENEOUS SLABS. VOLUME I: GAMMA RAY CODE Final Report, 15 Apr. 1961–14 Aug. 1963
Dominic J. Raso and Samuel S. Holland 8 Oct. 1963 71 p refs
(Contract DA-18-108-405-CML-1023)
(TO-B-63-73; AD-422292)

A multipurpose gamma ray and neutron Monte Carlo program for describing the emergent (backscattering or transmitted) characteristics (E,ω,Z) of photons or neutrons by slab has been written. The program is set up to investigate gamma ray or neutron backscattering, absorption, and transmission

in one, two, or three layers of different media. The information that may be obtained includes the number albedo or transmitted, the energy albedo or transmitted, and the angular distribution of the emergent number, energy, or dose. Sample results are given for both incident gamma rays and neutrons. Author

N64-31261 New York U., N.Y. Courant Inst. of Mathematical Sciences
ON THE PRINCIPLE OF LIMITING ABSORPTION
D. M. Eidus Aug. 1963 72 p refs Transl. from RUSSIAN
(Contract AF 19(604)-5238)
(EM-191; AFCRL-63-191; AD-421062)

Through a series of mathematical computations, the author proves the principle of limiting absorption. In practical problems, this principle states that if a boundary-value problem is solved for a medium that is slightly conducting, and then the conductivity is allowed to approach zero, the resulting limit of the solution is the solution of the same boundary-value problem in a nonconducting medium. The importance of this principle is that it is often simpler in mathematical analyses to introduce an artificial conductivity so that a solution may be more readily analyzed. A.W.

N64-31298 David Taylor Model Basin, Washington, D.C. Applied Mathematics Lab.
MODIFIED P_2 APPROXIMATIONS TO THE NEUTRON TRANSPORT EQUATION
Charles Dawson Apr. 1964 23 p refs
(DTMB-1814; AD-600986)

The steady-state neutron transport equation for slab geometry is expanded in Legendre polynomials. The expansion is truncated after the third term (P_2 equations) and then is modified in an attempt to reduce the truncation error. The resulting equations are, for many problems, a better approximation to the neutron transport equation than the P_2 equations or the standard diffusion equations. The method is extended to two and three dimensions by a simplified form of the spherical expansion to the neutron transport equation. Sample results are given. Author

N64-31300 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
AN ANALYSIS OF FAST-NEUTRON ENERGY-ANGLE DISTRIBUTIONS
R. E. Beissner 15 Aug. 1963 63 p refs
(Contract AF 33(657)-7201)
(NARF-63-5T; FZK-9-186; AD-416628)

The energy-angle distributions of fast neutrons transmitted through slab shields are analyzed. Comparisons of calculated and measured angle distributions show that a six-energy group, double P_2 approximation is adequate for polyethylene-slab calculations. Phenomenological arguments are presented showing that the transmitted energy-angle distribution can be described in terms of a simple asymptotic model. Suggestions for improving the asymptotic theory are included. Author

N64-31301 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
A SYSTEMIZATION AND PENETRATION STUDY FOR STRAIGHT CYLINDRICAL DUCTS
D. G. Collins and L. W. Mc Cleary 31 May 1963 36 p refs
(Contract AF 33(657)-7201)
(NARF-63-3T; FZK-9-182; AD-417282)

A study was conducted to determine the effect that varying the length and diameter of a straight cylindrical duct has on the neutron radiation streaming through the duct. An experiment was set up in which a polonium–beryllium source was located on centerline in the mouth of an aluminum duct penetrating a water slab. The resulting data were analyzed by use of two Monte Carlo procedures developed to analyze radiation streaming through cylindrical ducts. Results of additional calculations are shown to indicate the possibility of extending the experimental findings to duct problems involving different source energy and angular distributions and different shielding materials. Author

N64-31324 California U., Berkeley Lawrence Radiation Lab.
PHYSICS DIVISION SEMIANNUAL REPORT, NOVEMBER 1963–APRIL 1964
Luis W. Alvarez 25 May 1964 61 p refs
(Contract W-7405-ENG-48)
(UCRL-11466) OTS: $1.50

The various research projects being carried out at the laboratory are summarized. Research projects included are those involving bubble chambers, strange particles, scattering matrixes, kaon–proton interactions, elastic pion–proton scattering, high-energy scattering, and accelerators. P.V.E.

N64-31333* National Aeronautics and Space Administration, Washington, D.C.
A METHOD OF FINDING GREEN'S FUNCTION FOR BOUNDARY-VALUE PROBLEMS IN THE EQUATION OF HEAT CONDUCTION FOR A STRAIGHT-LINE SEGMENT WITH UNIFORMLY MOVING BOUNDARIES [METOD NAKHOZHDENIYA FUNKTSIY GRINA KRAYEVYKH ZADACH YRAVNENIYA TEPLOPROVODNOSTI DLYA OTREZKA PRYAMOY S RAVNOMERNO DVIZHUSHCHIMISYA GRANITSAMI]
V. I. Kval'vasser and Ya. F. Rutner Sep. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 6, 1964 p 1273–1276
(NASA-TT-F-9087) OTS: $1.00 fs; $0.50 mf

A general method of solution is given for a segment of a straight line with uniformly moving boundaries. The method is used to determine the Green's function, and it can also be used to solve certain boundary-value problems directly. The equation of heat conduction is put into a somewhat unusual form; the Green's function is made to satisfy certain boundary conditions; a moving coordinate system is introduced; a Riemann-Mellin formula transform and the Laplace transform are used; and a finite-difference equation is arrived at. A short solution of the finite-difference equation is noted. Features of the method for other boundary conditions and extension of the method to some other regions and boundary motion laws are mentioned. D.E.W.

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see:* 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-30356 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PLASMA PHYSICS AND THE PROBLEM OF CONTROLLED THERMONUCLEAR FUSION [VOL. 2, SECTION VII: PLASMA DIAGNOSTICS] Selected Articles

10 Jun. 1964 36 p refs Transl. into ENGLISH of Selected articles from the book, Kiev, Publ. House of the Acad. Sci. Uk. SSR, 1963 p 315–342
(FTD-MT-64-214; AD-602376)

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1. PLASMA DIAGNOSTIC BY SEVERAL FREQUENCIES L. A. Dushin, V. I. Kononenko, and A. I. Skibenko p 1–9 refs (See N64-30357 22-24)

2. STUDY OF THE SPATIAL DISTRIBUTION OF THE DENSITY OF ELECTRONS IN PLASMA BY MICROWAVES L. A. Dushin, V. I. Kononenko, and A. I. Skibenko p 10–16 refs (See N64-30358 22-24)

3. ON THE POSSIBILITY OF APPLICATION OF THE METHOD OF SCINTILLATIONS FOR REGISTRATION OF LOW-ENERGY IONS A. B. Rastrepin and I. M. Zolototrubov p 17–24 refs (See N64-30359 22-24)

4. ON MEASUREMENT OF THE PARAMETERS OF PLASMA IN A MAGNETIC FIELD V. Dubovoy and A. G. Ponomarenko p 25–34 refs (See N64-30360 22-24)

N64-30357 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PLASMA DIAGNOSTIC BY SEVERAL FREQUENCIES

L. A. Dushin, V. I. Kononenko, and A. I. Skibenko *In its* Plasma Phys. and the Probl. of Controlled Thermonucl. Fusion 10 Jun. 1964 p 1–9 refs (See N64-30356 22-24)

Experimental results are given in the determination of the density and the collision frequency of electrons in a pulse gas discharge. The measurements were made simultaneously at frequencies of 9.25, 37, and 74 Gc. Author

N64-30358 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STUDY OF THE SPATIAL DISTRIBUTION OF THE DENSITY OF ELECTRONS IN PLASMA BY MICROWAVES

L. A. Dushin, V. I. Kononenko, and A. I. Skibenko *In its* Plasma Phys. and the Probl. of Controlled Thermonucl. Fusion 10 Jun. 1964 p 10–16 refs (See N64-30356 22-24)

The simplest method of determination of spatial distribution is to measure attenuation or phase shift and to select the distribution function by comparison of the difference in the values obtained with those in the case of uniform distribution. Distribution of density can be found also from time dependencies of plasma decay. When plasma reaches a density higher than critical density for the given frequency, the microwave signal will be completely reflected. Through the process of sounding plasma by several frequencies, it is possible to trace the change of distribution of density by radius. A.W.

N64-30360 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ON MEASUREMENT OF THE PARAMETERS OF PLASMA IN A MAGNETIC FIELD

L. V. Dubovoy and A. G. Ponomarenko *In its* Plasma Phys. and the Probl. of Controlled Thermonucl. Fusion 10 Jun. 1964 p 25–34 refs (See N64-30356 22-24)

The interaction of electromagnetic waves of low amplitude with an ionized medium is successfully applied for the study of a number of basic processes in gas discharge. By direct measurements of the characteristics of wave propagation, the density of electrons, the collision frequency of electrons with remaining components of the plasma, and the electron temperature can be determined. The method is applicable to the study of processes both stationary and variable in time. Author

N64-30375 Case Inst. of Tech., Cleveland, Ohio

HALL EFFECT IN THE MHD RAYLEIGH PROBLEM

Pau-Chang Lu 1964 29 p refs
(NSF G-19000)

The influence of Hall effect in the Rayleigh's problem for an ionized gas at small Mach number is investigated. Advantage is taken of the small magnetic Prandtl number. The consequential neglect of the induced field is interpreted in two ways; each depicts a certain physical picture. The mathematical problem is the same for both. With the introduction of two complex functions, the problem is reduced to that without Hall effect, but with a complex conductivity. Thus, solutions can be obtained by a splitting up into real and imaginary parts known solutions of the MHD Rayleigh's problem without Hall effect. An approximate solution is obtained for the cases with small magnetic Prandtl number by a Kármán–Pohlausen-like technique, and compared with the corresponding exact solution. Author

N64-30427 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)

MAGNETOPLASMADYNAMIC POWER GENERATION RESEARCH PROGRAMME. PART I: MPD CLOSED-LOOP Technical Summary Report, 1 Dec. 1962–31 Mar. 1964

B. C. Lindley [1964] 230 p refs
(Contract N62558-3127; ARPA Order 209-62)
(IRD-64-36; AD-602381) OTS: $6.00

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1. INTRODUCTION: ENERGY CONVERSION PROGRAMME B. C. Lindley 13 p refs (See N64-30428 22-24)

2. DEVELOPMENT OF CLOSED LOOP R. Brown, W. J. Slator, W. Morrison, J. Davidson, K. Cass et al 14 p (See N64-30429 22-10)

3. HIGH TEMPERATURE GAS CIRCULATION R. Brown, W. J. Slator, V. Brown, K. Cass, and J. Davidson 61 p (See N64-30430 22-10)

4. POWER GENERATION R. Brown, W. J. Slator, V. Brown, K. Cass, and J. Davidson 2 p (See N64-30431 22-10)

5. MPD EXPERIMENTS WITH A HELIUM-CESIUM LOOP B. C. Lindley, R. Brown, and I. R. Mc Nab 19 p refs (See N64-30432 22-24)

6. HIGH TEMPERATURE HEATER R. Brown, W. J. Slator, K. Cass, V. Brown, and J. Davidson 7 p (See N64-30433 22-10)

7. HELIUM PURIFICATION ON ANALYSIS R. Brown, J. Davidson, W. Slator, and A. Bottom 5 p (See N64-30434 22-10)

8. CESIUM INJECTION AND RECOVERY R. Brown, W. J. Slator, T. Archbold, V. Brown, K. Cass et al 22 p (See N64-30435 22-10)

9. GENERATOR DUCT R. Brown 13 p (See N64-30436 22-10)

10. INSTRUMENTATION F. B. Jones, W. Jackson, J. Blunt, R. Brown, and I. R. Mc Nab 17 p (See N64-30437 22-15)

11. MATERIALS 35 p refs (See N64-30438 22-18)

12. COMPATIBILITY OF MPD REFRACTORY MATERIALS WITH CESIUM VAPOUR G. Arthur 13 p refs (See N64-30439 22-17)

N64-30428 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)

INTRODUCTION: ENERGY CONVERSION PROGRAMME

B. C. Lindley *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. I: MPD Closed Loop [1964] 13 p refs (See N64-30427 22-24) OTS: $6.00

The present research program on MPD power generation is closely associated with the possibility of utilizing a high-temperature nuclear-reactor heat source in conjunction with an MPD generator and steam cycle. One of the important aspects of closed-cycle MPD electrical-power generation being studied is the possibility of using enhanced (sic) ionization, particularly when this effect is due to elevated electron temperature. Plasma-physics studies include the following. Thermally excited plasmas are being studied, using microwave techniques to measure electron concentrations and collision frequencies in helium–cesium mixtures, at pressures ranging from 1 to 760 torr, and at temperatures ranging from 1,000° to 2,300° K, to establish basic data at the appropriate particle energies. Cesium atom–helium atom and cesium ion–helium atom collision cross sections are being measured. Photon cross sections and recombination coefficients in plasma irradiated with light energy are being studied. The theoretical work on closed-cycle systems is related mainly to MPD power generation from a nonequilibrium plasma flow. P.V.E.

N64-30432 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
MPD EXPERIMENTS WITH A HELIUM-CESIUM LOOP
B. C. Lindley, R. Brown, and I. R. Mc Nab *In its* Magnetoplasma Dyn. Power Generation Res. Programme. Pt. I: MPD closed Loop [1964] 19 p refs Presented at The Internatl. Symp. on Magnetohydrodyn. Elec. Power Generation, Paris, Jul. 1964 (See N64-30427 22-24) OTS: $6.00

In the MPD closed-cycle loop discussed, continuously filtered and purified helium passes through an electrical resistance heater (to stimulate the nuclear reactor) capable of producing gas temperatures up to 2,500° K. A metered flow of cesium vapor is introduced before the mixture expands to a high velocity through a rectangular-section nozzle. In the arrangement discussed, a supersonic flow of helium and ionized cesium passes through the MPD generator duct (alumina or boron nitride) and a subsonic diffuser to a recuperative heat exchanger and the final cooler. Cesium is removed in a cold trap before the helium reenters the circulator. The operation of this loop, along with various experiments carried out, is outlined. These are the conclusions: (1) The technological feasibility of a closed-cycle high-temperature (up to 2,500° K) loop for MPD direct electrical-power generation has been demonstrated. (2) Preliminary power-generation experiments with cesium-seeded helium indicated electrical outputs at least equivalent to thermal ionization. P.V.E.

N64-30440 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
MAGNETOPLASMADYNAMIC POWER GENERATION RESEARCH PROGRAMME. PART 3: THEORETICAL Technical Summary Report, 1 Dec. 1962–31 Mar. 1964
B. C. Lindley [1964] 237 p refs
(Contract N62558-3127; ARPA Order 209-62)
(IRD-64-36; AD-602383) OTS: $6.00

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1. VISCOSITY OF MPD WORKING FLUIDS I. R. Mc Nab 34 p refs (See N64-30441 22-11)
2. COLLISION CROSS SECTIONS I. R. Mc Nab 7 p refs (See N64-30442 22-24)
3. SEED FRACTION OPTIMIZATION I. R. Mc Nab 28 p refs (See N64-30443 22-24)
4. NOZZLE FLOW I. R. Mc Nab 23 p refs (See N64-30444 22-24)
5. FLOW PROCESSES IN MPD GENERATORS I. R. Mc Nab 73 p refs (See N64-30445 22-24)
6. THE CONSTANT MACH NUMBER MPD GENERATOR T. S. Wilkinson 10 p refs (See N64-30446 22-24)
7. OPTIMIZATION OF LARGE-SCALE NUCLEAR MPD SYSTEMS B. C. Lindley and I. R. Mc Nab 15 p refs (See N64-30447 22-24)
8. POWER CONVERSION IN SPACE I. R. Mc Nab 25 p refs (See N64-30448 22-06)
9. A NON-EQUILIBRIUM ELECTRON MODE FOR KILOWATT-RANGE MPD SPACE POWER I. R. Mc Nab 16 p refs (See N64-30449 22-06)
10. NON-EQUILIBRIUM PLASMAS I. R. Mc Nab 8 p refs (See N64-30450 22-24)

N64-30442 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
COLLISION CROSS SECTIONS
I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. 3: Theoret. [1964] 7 p refs (See N64-30440 22-24) OTS: $6.00

The basic equations for determining collision cross sections are presented, and it is shown that the substitution of the elastic scattering frequency (ν_0) for the collision frequency for momentum transfer (ν_M) is not valid for cesium. Experimental measurements reported in the literature for cesium collision cross sections and collision frequencies are reviewed. If all the reported experimental data are correct, the cross section of cesium atoms at low energies exhibits an unexpected energy dependence. Reference to the experimental values shows that a constant cesium atom cross section of $300 \times 10^{-16} cm^2$ is a reasonable approximation. M.P.G.

N64-30443 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
SEED FRACTION OPTIMIZATION
I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. 3: Theoret. [1964] 28 p refs (See N64-30440 22-24) OTS: $6.00

When extra thermal ionization in closed-cycle magnetoplasmadynamic generators is magnetically induced, the ionic scattering of electrons becomes important in determining the electrical conductivity, and the optimum seed fraction becomes a function of the working conditions of the generator. The selection of optimum seed fraction and the consequences of temperature dependence are examined for a segmented electrode generator, for a solid electrode generator, and for a Hall generator. The values used for the gas parameters (T = 1,000° K and p = 1 atm) are considered typical for a large-scale closed-cycle nuclear magnetoplasmadynamic generator, and the methods and conclusions relate to elevated electron temperatures and low gas temperatures. The optimum seeding fraction for a segmented-electrode generator is close to 1 at. percent; for a solid-electrode generator the optimum is within the range $0.1 < X < 0.01$, where X is the seeding fraction; and for a Hall generator the optimum is < 0.01 at. percent. M.P.G.

N64-30444 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)
NOZZLE FLOW
I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res Programme. Pt. 3: Theoret. [1963] 23 p refs (See N64-30440 22-24) OTS: $6.00

Extremely rapid expansion of the working fluid through a large-area-ratio nozzle to produce a high rate of fall of gas temperature has been proposed as a method of producing extrathermal ionization in closed-cycle magnetoplasmadynamic

generators. In order to examine the consequences of such nonequilibrium nozzle flow on the design and power output of MPD generators, theoretical calculations were carried out for T_0 = 1500° and 2000° K at p_0 = 1 atm in a helim–cesium mixture for both equilibrium and nonequilibrium conditions. A comparison of the results shows that the nonequilibrium power density at the nozzle exit for T_0 = 1500° K is approximately the same as the equilibrium power density at the optimum Mach number for T_0 = 2000° K. Therefore, operation of a nozzle to give semifrozen flow (as far as electrical conductivity is concerned) permits the same power density to be achieved at a stagnation temperature about 500° K lower than for the equilibrium case. M.P.G.

N64-30445 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)

FLOW PROCESSES IN MPD GENERATORS

I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. 3: Theoret. [1964] 73 p refs (See N64-30440 22-24) OTS: $6.00

Theoretical analyses of the processes occurring during constant area flow in a magnetoplasmadynamic-generator channel were conducted for three conditions: zero magnetic field, equilibrium at the gas temperature, and elevated electron temperature. The effect of varying both the magnetic field and the load factor was investigated for each of the three conditions. The effect of supersonic–subsonic transition in the expansion nozzle–MPD channel-diffuser system was included, as well as the effects of flow regime, channel-wall losses, electrode processes, end loop and leakage losses, and cesium dissociation. The results obtained are discussed in relation to the design of a MPD generator. Preliminary results obtained with a more versatile computer program, which includes the equation governing magnetically induced ionization nonequilibrium, are also discussed. M.P.G.

N64-30446 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)

THE CONSTANT MACH NUMBER MPD GENERATOR

T. S. Wilkinson *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. 3: Theoret. [1964] 10 p refs (See N64-30440 22-24) OTS: $6.00

Equations describing a general theory of constant Mach-number flow of a monatomic gas in any magnetoplasmadynamic generator are proposed. Various types of generators are discussed as special cases within the framework of the general theory; these include segmented electrodes, continuous electrodes, Hall generator, series-connected generator, angled current generator, and angled potential generator. The equations have been programed, and preliminary calculations have drawn attention, in the case of Hall generators, to a phenomenon akin to voltage breakdown. The efficiency of the expansion is reduced considerably as a consequence of electron-temperature elevation due to the presence of a magnetic field. If verified, this effect could preclude the use of Hall generators altogether. M.P.G.

N642-30447 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)

OPTIMIZATION OF LARGE-SCALE NUCLEAR MPD SYSTEMS

B. C. Lindley and I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. 3: Theoret. [1964] 15 p refs Presented at the Internatl. Symp. on Magnetohydrodyn. Elec. Power Generation, Paris, 6–10 Jul 1964 (See N64-30440 22-24) OTS: $6.00

In helium–cesium mixtures at typical reactor operating pressures (10 ata) magnetically induced extra thermal ionization will not be of consequence in a typical subsonic segmented-electrode MPD generator unless magnetic fields of greater than 5T are used. In argon–cesium mixtures considerable nonequilibrium effects will occur; typically, for p_0 = 10 ata, B = 5T, the nonequilibrium specific power is approximately twice the equilibrium specific power. As the operating Mach number of the MPD generator is increased, nonequilibrium effects become increasingly important, but for helium–cesium mixtures the effects are not significant for a reactor operating pressure of 10 ata even with a Mach number of 1.4. For argon–cesium mixtures the specific power at Mach numbers greater than 1.4 increases beyond the maximum at M $\simeq$ 0.5, and the actual specific power is greater than for helium–cesium. Author

N64-30450 International Research and Development Co., Ltd., Newcastle (Gt. Brit.)

NON-EQUILIBRIUM PLASMAS

I. R. Mc Nab *In its* Magnetoplasmadyn. Power Generation Res. Programme. Pt. 3: Theoret. [1964] 8 p refs (See N64-30440 22-24) OTS: $6.00

Three approaches to calculating recombination and ionization mechanisms in nonequilibrium plasmas are being investigated: (1) a three-level model of a cesium plasma in which only electronic and radiative processes are considered; (2) a many-level system of a cesium plasma with the same two processes; and (3) a three-level model of a cesium–helium plasma in which atomic processes are considered in addition to electronic and radiative processes. Only the first investigation has reached the stage where results can be given. These include rate coefficients for recombination and ionization mechanisms, as based on expressions for collisional excitation, collisional ionization, radiative deexcitation, and radiative recombination. M.P.G.

N64-30472 Avco-Everett Research Lab., Everett, Mass.

DETAILED PERFORMANCE EVALUATION OF THE MARK V SELF-EXCITED MHD GENERATOR ENGINEERING SERVICES FOR INVESTIGATION OF THE EFFECTS OF VARIATION OF MASS FLOW, LOADING, SEED CONCENTRATION, AND MAGNETIC FIELD STRENGTH ON THE PERFORMANCE OF THE MARK V 20-MEGAWATT GENERATOR Quarterly Technical Summary Report

Jul. 1964 17 p

(Contract AF 33(615)-1862; ARPA Order 291)

(AD-443597)

An understanding has been sought of the self-excitation characteristics of the generator, during which means were found to increase performance toward a rated power level. The report includes the time-phase series of tests conducted, the problems encountered, and the steps taken in solving them. The major problem was that of voltage breakdown between electrodes. This was solved by controlling the voltage distribution in the inlet section. Eight power tests were run; mass flows, seed rates, and loading configurations are included for each test; and curves of the self-excitation-time characteristics are shown for four of the tests. A discussion is also included of generator modifications, both to major generator compo nents and to data-taking systems. A.W.

N64-30478 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

ON MEASURING THE CONDUCTIVITY OF A WEAKLY IONIZED PLASMA BY HIGH FREQUENCY SOUND [SUR LA MESURE PAR SONDE HAUTE FREQUENCE DE LA CONDUCTIVITE D'UN PLASMA FAIBLEMENT IONISE]

Thiebault Moulin and Jean Masse 1964 20 p refs In FRENCH Presented at the Internatl. Symp. on the Magneto-Hydrodynamic Production of Elec. Energy, Paris, 6–10 Jul. 1964
(TP-111 (1964))

The use of a solenoid that supplies a high-frequency current appears suitable for measuring the conductivity of a weakly conductive medium. When the physical characteristics of the medium studied are constant or slowly variable, the use of an over-pressure meter allows the precise determination of the apparent resistance and the eddy capacity of the coil, corresponding to the introduction of a conductor core. When experimental conditions necessitate the use of circuitry with weak time constants, the study of the damping of an oscillating circuit, in which the coil is integrated, leads also to the value of the apparent resistance. A theoretical study of the circuitry confirms, with good precision, the formulas for rating (calibrating) sounds, and it predicts the effects due to the scale limitation of the coil and to the eddy capacity. Trans. by I.v.L.

N64-30480 California Inst. of Tech., Pasadena Daniel and Florence Guggenheim Jet Propulsion Center
NON-EQUILIBRIUM ELECTRICAL CONDUCTIVITY IN A SEEDED PLASMA
E. E. Zukoski, T. A. Cool, and E. G. Gibson Apr. 1964 53 p refs
(Contract AF 49(638)-1285)
(AFOSR-64-0848; AD-602683) OTS: $3.00

Measurements of conductivity have been made in a plasma composed of argon seeded with potassium vapor. The gas temperature was 2,000° K; the pressure, one atmosphere; the potassium concentration was between 0.22 and 0.80 mole %; and the current density was between 1 and 80 amp/cm^2. Conductivity values were calculated from a two-temperature model in which the energy dependence of the cross sections and radiation losses from the plasma are taken into account. The theoretical and experimental values are in excellent agreement. Measured values of the plasma temperatures appear to be about 10% less than predicted. Relaxation times for the conductivity in response to a step function change in the electric field were found to be proportional to $(n_{e_0}/\sigma_o E^2)$ and were a few tens of microseconds for a field strength in the range 3 to 10 v/cm. Author

N64-30490 Paris U., Orsay (France) Lab. des Hautes Energies
ON THE COLLECTIVE DESCRIPTION OF CLASSICAL PLASMAS
G. Kalman [Apr. 1964] 109 p refs
(Contract AF 61(052)-613)
(LP-36; ARL-64-140; AD-602410) OTS: $4.00

Collective coordinates are considered as a linear transformation of deviations from the unperturbed orbit. In general they are admixtures of particle coordinates and of particle momenta. On this basis a reformulation and generalization of the Bohm–Pines theory and a classical equivalent of Brout's method is introduced. The correspondence of the two treatments is demonstrated. The method developed is employed to establish a collective description of magnetostatic interaction. A Hamiltonian describing magnetic interaction in terms of particle variables is derived. This serves as a starting point. The Fourier transform of the momentum density appears as a collective coordinate. Subsequent canonical transformations lead to a collective fluid-like description, to an extended Hamiltonian with coupling, and to dressed uncoupled collective variables. A new collective mode with two transverse polarizations emerges; it exhibits an unstable behavior and prevails in the case of unisotropic velocity distribution only. Author

N64-30509* Avco-Everett Research Lab., Everett, Mass.
EXPERIMENTS WITH MAGNETOHYDRODYNAMICALLY SUPPORTED SHOCK LAYERS
E. Locke, H. E. Petschek, and P. H. Rose Aug. 1964 42 p refs
(Contract NASw-748)
(NASA-CR-58823; RR-191) OTS: $2.00 fs; $0.50 mf

Shock-tube experiments have been performed to quantitatively determine the interaction of a hypersonic flow with the magnetic field of a straight current-carrying wire oriented perpendicular to the flow direction. Most of the experimental work was performed in a 50-50 mixture of argon and oxygen, at an initial pressure of 1-mm Hg, and in a range of shock velocities between 4.3 and 6 mm/μsec. Data have been obtained by observing the flow luminosity, using an image converter and mirror camera looking both perpendicular to and along the wire. A circular shock front was observed to stand up to 5 1/2 cm in front of a 1-cm-radius cylinder producing the magnetic field. The data on shock position vs current were in excellent agreement with theory. Author

N64-30549 Paris U., Orsay (France) Lab. des Hautes Energies
LONGITUDINAL DIELECTRIC CONSTANT OF A FULLY IONIZED PLASMA Technical Note No. 6
J. Coste 15 Nov. 1963 64 p refs
(Contract AF 61(052)-613)
(LP-31; ARL-64-45; AD-432688)

Starting from the kinetic equations of Guernsey, and using a high-frequency or short wavelength approximation, the dielectric constant $\epsilon(k,\omega)$ of a plasma is found. This dielectric constant contains the effects of the correlations, up to the first order in the expansion plasma parameter. Equilibrium quantities are obtained from $\epsilon(k,0)$. Author

N64-30604* General Electric Co., Philadelphia, Pa. Space Sciences Lab.
CONTINUOUS MICROWAVE MAGNETIC ACCELERATOR Summary Report, 8 Aug. 1963–7 Aug. 1964
David B. Miller [1964] 109 p
(Contract NAS3-3567)
(NASA-CR-54134; Rept.-214-S89-TSR) OTS: $4.00 fs; $0.75 mf

A cyclotron-resonance accelerator (8.35 gc) was tested up to 4,150 watts, and was shown under proper conditions to convert over 50% of the incident RF power into directed motion of the accelerated exhaust stream. Continuous operating times at these several kilowatt power levels were typically 1 to 4 minutes. Total and sampling collectors were used to measure power and ion-flux density within the accelerated plasma stream. Calorimetry in the thrustor walls, shielded antenna probes, bare-electrode probes, and a microwave reflectometer yielded additional thrustor characteristics. Author

N64-30640 Nihon U., Tokyo (Japan) Coll. of Science and Engineering
ON THE MECHANISMS OF ACCELERATION OF HIGH ENERGY ELECTRONS IN A THETA-PINCH
Masatomo Sato and Ichiro Kawakami [1963] 46 p refs
(NUP-64-8)

The mechanisms of acceleration of high-energy electrons in a theta-pinch are investigated, and it is concluded that a single-particle induction mechanism, by itself, is not sufficient to account for the observed 300 kev X-rays in a slow theta-pinch. As an additional acceleration mechanism, the effect of space-charge electric field, which may act to

establish a stable orbit of electrons analogous to the betatron orbit, is proposed. A brief mention is also given to the possible roles of the plasma bunches that would be produced as a result of the beam-plasma instabilities. Author

N64-30695 Northrop Corp., Hawthorne, Calif. Northrop Space Labs.
PLASMA PROPERTIES BY MOMENTUM CHANGE Final Report
P. D. Lenn and D. L. Ward Washington, D.C., AFOSR, May 1964 76 p refs
(Contract AF 49(638)-1160)
(AFOSR-64-1000; AD-603097) OTS: $3.00

The use of the momentum change technique to determine average properties of a plasma from its interaction with applied electric and magnetic fields was investigated. Experiments were performed using a linear crossed-field accelerator. An analysis for the calculation of average values of the scalar conductivity, Hall coefficient, and ion slip coefficient is developed and applied to experimental results obtained with argon at the pressures of 2, 4, and 8-mm Hg. From those values, the electron temperature and number density and the mean electron–ion collision time were calculated. Assuming a relation between the electron and heavy-particle temperatures, the heavy-particle densities, the mean ion–atom collision time, and the ion–atom collision cross section were calculated. The experimental and total uncertainties of the results are estimated. Author

N64-30744 RAND Corp., Santa Monica, Calif.
THE TERRESTRIAL RING CURRENT
Ernest C. Ray Jul. 1964 21 p refs Submitted for Publication
(P-2939; AD-443406)

Several people have computed numerically the magnetic field caused by an axially symmetric body of plasma imbedded in a dipole magnetic field. In this paper an approximate formula is derived for this magnetic field, without first choosing a particular functional form for the plasma density. As a result any particular case can be discussed without recourse to a computer, whereas previous treatments resulted in a tabulation of an answer for a particular case only, and new cases required new computer runs. The method used avoids the usual fine net required by the singularity in the integrand. This is achieved by constructing a new quadrature formula that treats this singularity exactly. The then permitted coarse net makes possible an algebraic treatment, rather than a numerical one. Author

N64-30763 Microwave Electronics Corp., Palo Alto, Calif.
STUDY OF MICROWAVE GENERATION UTILIZING DOUBLE-STREAM INSTABILITIES IN ANISOTROPIC MEDIA First Quarterly Progress Report, 4 Nov. 1963–31 Jan. 1964
F. A. Olson and L. D. Buchmiller [1964] 37 p refs
(Contract DA-36-039-AMC-03424(E))
(Rept.-1; AD-603321) OTS: $2.00

A physical basis for the amplification of an RF signal by the interaction between counterstreaming beams of negative and positive charges is presented. The description and analysis for this discrete-velocity double-stream amplification process provides a simplified analogy to the operation of the double-stream amplifier, utilizing pyrolytic graphite. The characteristics of pyrolytic graphite that are important to the existence of double-stream instabilities are also discussed. The material offers a two-component plasma with electron and hole densities of 6×10^{18} cm^{-3} and mobilities on the order of 10^5 cm^2 – $volt^{-1}$–sec^{-1} at room temperature. The effective masses of the holes and electrons are extremely small so that the long relaxation times required for the two-stream instability process are possible. Author

N64-30852* Consultants and Designers, Inc., Arlington, Va.
POST-LUMINESCENCE OF ATOMIC LINES OF HYDROGEN INTRODUCED IN THE RARE GASES IN THE STATE OF IMPURITY [POST-LUMINESCENCE DES RAIES ATOMIQUES DE L'HYDROGENE INTRODUIT A L'ETAT D'IMPURETE DANS LES GAZ RARES]
Andre Ricard 16 Sep. 1964 7 p Transl. into ENGLISH from Compt. Rend. Acad. Sci. Spectroscopie Atomique (France), v. 259, Group 6, 6 Jul. 1964 p 89–92
(Contract NAS5-3760)
(NASA-TT-F-8959; ST-AS-10208) OTS: $1.00 fs; $0.50 mf

The anomalous postluminescence of hydrogen impurities in a helium or neon plasma excited in pulses is studied. The characteristic parameters of the phenomenon—intensity and time constant—depend on the nature and proportions of the mixture, the dimensions of the pattern, and the observed zone. Author

N64-30854* Consultants and Designers, Inc., Arlington, Va.
ON THE ACCELERATION FACTOR OF THERMONUCLEAR REACTIONS IN A VERY COMPRESSED HYDROGEN PLASMA [SUR LE FACTEUR D'ACCELERATION DES REACTIONS THERMONUCLEAIRES DANS UN PLASMA D'HYDROGENE TRES COMPRIME]
M. Jean-Louis Bobin 14 Sep. 1964 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. Phys. Plasmas (Paris), v. 259, 6 Jul. 1964 p 77–79
(Contract NAS5-3760)
(NASA-TT-F-8961; ST-PP-NP-10206) OTS: $1.00 fs; $0.50 mf

After determining the lowering of the potential threshold due to electrons, the acceleration factors and the average reaction times in stellar conditions are computed, and new average times of the proton-proton cycle reactions are derived, starting from the rates of fusion given by Pecker and Schatzmann. Author

N64-30856* Consultants and Designers, Inc., Arlington, Va.
COMPENSATION OF AN ION SPACE CHARGE BY ELECTRONS IN A MAGNETIC FIELD [O KOMPENSATSII IONNOGO PROSTRANSTVENNOGO ZARYADA ELEKTRONAMI V MAGNITNOM POLE]
V. N. Danilov 25 Sep. 1964 7 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 8, 1964 p 1530–33
(Contract NAS5-3760)
(NASA-TT-F-8963; ST-EE-10213) OTS: $1.00 fs; $0.50 mf

The problem is considered of compensation in high-vacuum conditions of an ion beam's space charge by electrons, emitted from a grid, through which the ion beam passes freely in a two-dimensional magnetic field. A mathematical analysis of the problem is presented in which the following boundary conditions are employed: (1) The thermal velocities of the electrons are neglected. (2) The electric current of the grid is restrained by the space charge. (3) The magnetic lines of force do not intersect the surface of the grid. P.V.E.

N64-30879 Physics International, Inc., Berkeley, Calif.
TWO QUANTUM STATISTICAL TREATMENTS OF SPECTRAL LINE SHAPES EMITTED FROM PLASMAS Final Report
T. Nakayama and H. E. De Witt Kirtland AFB, N. Mex., Res. and Technol. Div., Jun. 1964 84 p refs
(Contract AF 29(601)-5699)
(RTD-TDR-63-3130; AD-603003) OTS: $3.00

This work contains two different quantum statistical approaches to the problem of determining the spectral line shape

emitted from a plasma: (1) Hydrogenic energy levels as modified by the plasma are studied through a perturbation expansion of the partition function of the multicomponent plasma, which gives rise to a pseudo-Schroedinger equation. The level shift and width are calculated using the random phase approximation for the dielectric function of the plasma. (2) A formal treatment is given to radiative transitions between two levels in which the dipole-dipole correlation function is developed in a perturbation expansion along the lines of recent work on transport coefficients. Author

N64-30897 California Inst. of Tech., Pasadena Quantum Electronics Lab.
STUDIES ON OPTICAL SCATTERING AS A TECHNIQUE FOR PLASMA DIAGNOSTICS Scientific Report No. 1
S. E. Schwarz May 1964 111 p refs Sponsored in Part by NASA
(Contract AF 49(638)-1322)
(AFOSR-64-1143; AD-603738)

When a pulse of intense light from a giant-pulse laser passes through a plasma, a very small fraction of the light is scattered out of the beam as a result of (Thomson) scattering by free electrons. Under suitable conditions the intensity of the scattered light is proportional to the density of free electrons, and its spectral distribution is related to the velocity distribution of the free electrons through the doppler formula. Theoretical considerations, relating to the conditions of validity of the method, are discussed. Various mechanisms that could interfere with the diagnostic technique are mentioned, and their importance is considered. Design considerations for diagnostic experiments are then taken up, and signal-to-noise ratios calculated. Author

N64-30907 Columbia U., New York, N.Y. Plasma Lab.
PROGRESS TOWARD A NEON-HYDROGEN LASER AND APPLICATIONS OF OPTICAL PUMPING FOR LASER CROSS-MODULATION Annual Technical Summary Report
Thomas C. Marshall Jun. 1964 37 p refs
(Contract Nonr-266(93))
(AD-603405)

Certain further measurements of the Ne-H_2 mixture are elaborated and refined, and further problems relating to the operation of a Ne-H_2 laser are discussed. Some preliminary results are presented of a series of experiments designed to study, demonstrate, and utilize the effect of high-power optical radiation on an ensemble of metastables that may be contained in an operating laser. The details are reported of a successful attempt to cross-modulate the laser output with an external incoherent optical source and to point out its implications. Author

N64-30981 Illinois U., Urbana Electrical Engineering Research Lab.
FREE AND DRIVEN MODES IN ANISOTROPIC PLASMA GUIDES AND RESONATORS
Robert Likuski Wright-Patterson AFB, Ohio, AF Avionics Lab., Jul. 1964 204 p refs
(Contract AF 33(657)-10224)
(AL-TDR-64-157; AD-604087)

Starting with Maxwell's equations containing arbitrary electric and magnetic sources, a set of uncoupled wave equations has been formulated for an anisotropic plasma. Expressions for determining the electromagnetic field components in terms of the solutions of these equations and the transverse currents have been derived and tabulated. Setting the sources equal to zero, the characteristic equations have been obtained for the axially symmetric free modes in a circular cylindrical plasma-filled guide, open plasma guide, and coaxial plasma guide. Extensive numerical evaluations of the characteristic equation representing the plasma-filled guide have been made for the lowest order mode, and a set of ω–β curves is presented for plasma densities, magnetic fields, phase velocities, and guide radii varying from zero to infinity. Author

N64-31068 ARO, Inc., Arnold Air Force Station, Tenn.
THE MAGNETOHYDRODYNAMIC ARC THRUSTER
Peter A. Schoeck Arnold Eng. Develop. Center, Sep. 1964 28 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-182; AD-447481)

The effect of the self-induced magnetic field of an electric arc of diverging-current cross section with an electrode configuration suitable for a thruster is investigated. Basic relationships for thrust, jet velocity, and mass flow rate are developed in terms of arc parameters that are current, voltage, and electrode parameters for a simplified arc model. It is predicted that with currents on the order of 1000 A, voltages on the order of 100 V, and mass flow rates on the order of 10^{-2} to 10^{-1} g-sec^{-1}, jet velocities on the order of 10^5 m-sec^{-1}, and thrusts on the order of one Newton can be achieved; therefore the arc jet could be used as a thruster for space missions that heretofore were thought to be restricted to electrostatic propulsion. Author

N64-31069 ARO, Inc., Arnold Air Force Station, Tenn.
SPECTROSCOPY OF A SUPERSONIC PLASMA. II. EXCITATION TEMPERATURE
LeRoy E. Breqer Arnold Eng. Develop. Center, Sep. 1964 30 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-196; AD-447735)

The excitation temperature of a low-density, supersonic, argon plasma stream produced by a conventional dc plasmajet was measured spectroscopically at 14 axial plasma-stream locations. The relative intensities of several neutral argon atomic lines were utilized with a conventional line-slope distribution temperature method to obtain the results. It is shown that metastable atoms, known to be present in excess quantities in the plasma, have no effect on the excitation temperature measurements. The temperature was found to drop rapidly from 13,500° K near the arc to 6,300° K at the position of the normal shock 2.5 in. downstream. It then rose slightly to approximately 7,800° K and held fairly constant for a distance of several inches downstream. Author

N64-31087* Maryland U., College Park
"TEST PARTICLE" PROBLEM FOR AN EQUILIBRIUM PLASMA
D. A. Tidman, R. L. Guernsey, and D. Montgomery Repr. from Phys. of Fluids, v. 7, no. 7, Jul. 1964 3 p refs
(Grant NsG-220-62)

A Fokker–Planck equation is derived for a "test particle" distribution from the many-species Balescu–Lenard equation. The friction and dispersion coefficients are reduced to simple expressions for the fast "test particles," and are compared with those previously calculated by Rostoker and Rosenbluth, who employed other methods. Two advantages of the reported calculation over those by Rostoker and Rosenbluth are these: (1) It is much more straightforward. (2) It yields a Fokker–Planck equation for which there is no limitation in time, and which predicts a relaxation to a Maxwell distribution. I.v.L

N64-31100 Cornell U., Ithaca, N.Y. Graduate School of Aerospace Engineering
[RESEARCH ON GASES] Final Report, 1 May 1962–30 Apr. 1964
W. R. Sears 15 Jun. 1964 3 p refs
(Grant AF-AFOSR-62-201)
(AD-601730)

Areas of research in the field of high-temperature magnetogasdynamics are listed. The status of work on flow past a blade oscillating in a viscous fluid is reported. Analytical work on rarefied Couette flow with large temperature differences was completed, and a program written to obtain numerical results. The investigation of the transition from free-molecular flow to continuum flow was essentially completed, lacking only numerical results. A number of references to articles published by the investigators are included. D.E.W.

N64-31136 General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
THE RADAR ABSORPTION EFFECT CAUSED BY VERY THIN PLASMA SHEATHS
H. M. Musal, Jr. and W. E. Blore Jul. 1964 21 p refs
(Contract DA-04-495-ORD-3567(2); ARPA Order 357-63; Proj. Defender)
(CTN64-02; AD-444071)

It is shown theoretically that anomalous absorption may be a diffraction effect caused by the gradient of the electron density in the plasma sheath around the body. That is, the effect occurs when the body is only partially covered by an overdense plasma sheath. This plasma layer can be very thin compared to the wavelength of the radar wave and still cause a significant decrease in the radar cross section. These results are illustrated by several theoretical graphs that show the dependence of the radar cross section of a metal sphere partially covered by a plasma layer on the size, thickness, and properties of the layer. Author

N64-31140 Internal Research and Development Co., Ltd., Newcastle (Gt. Brit.)
FLOW PROCESSES IN MPD GENERATORS
I. R. Mc Nab and N. A. Cooper Oct. 1963 60 p refs
(Contract N62558-3127)
(IRD-63-82; AD-422399)

This preliminary report on flow processes in MPD generators is concerned particularly with the conditions in the first test section of the IRD generator. Thus the flow equations have been solved for a constant area channel with supersonic flow and include the effects of power extraction, heat loss, wall friction, and nonconstant electrical conductivity. The electrical conductivity depends on the electron density, which may be at the thermal equilibrium value, or above it if electron heating occurs. Solutions for both cases are investigated, and the assumptions inherent in the solution of the flow equations are considered. Author

N64-31202* Rensselaer Polytechnic Inst., Troy, N.Y.
THE PROBABILITY OF COLLISION FOR MOMENTUM TRANSFER OF SLOW ELECTRONS IN A NITROGEN PLASMA AFTERGLOW
Joseph Ajello Washington, NASA, Oct. 1964 59 p refs
(Grant NsG-48-60)
(NASA-CR-104) OTS: $1.50

The purpose of this experiment was to measure the probability of collision for momentum transfer of slow electrons in a weakly ionized nitrogen plasma afterglow. The probability of collision was calculated in the late afterglow on the basis of a hard sphere model interaction between electrons and neutrals. The value obtained over the energy range 0.040 eV to 0.078 eV is 18.1 ± 1.6 (cm torr)$^{-1}$. The time taken by the electron gas to relax from the high temperature of the active discharge to room temperature and to a Maxwellian distribution is found to be much longer than that predicted by a consideration of elastic collisions between electrons and neutrals. As expected, the rate of relaxation to room temperature and to a Maxwellian distribution is a sharp function of pressure. The reason for these effects is ascribed to the disturbance of the afterglow by interactions involving metastable nitrogen particles. Author

N64-31236 Uppsala U. (Sweden) Inst. of Physics
NONLINEAR DISTORTION OF PERIODIC MAGNETOHYDRODYNAMIC WAVES
S. I. Herlitz Mar. 1963 10 p refs
(Grant AF-EOAR-62-109)
(ARL-63-196; AD-420545)

A method for calculating the frequency spectrum of a nonlinearly distorted, time-periodic sound wave, is generalized slightly and applied to nonlinear magnetohydrodynamic waves. Two examples are considered. The first, a longitudinal wave propagating across a magnetic field, is closely analogous to an ordinary sound wave. The second example is a nonlinear generalization of a plane-polarized Alfvén wave. It is shown that odd overtones develop in the transverse component of the magnetic field. Author

N64-31246 Raytheon Co., Wayland, Mass. Advanced Development Lab.
INVESTIGATION OF MICROWAVE COUPLING AND ENERGY PARTITION AND TRANSPORT WITHIN A PLASMA, VOLUME 2. CHAPTER 2: THE MEASUREMENT OF THREE-BODY ELECTRON-ION RECOMBINATION IN A DENSE PLASMA Scientific Report No. 3 (Final)
Edward Rolfe and John Kevin Silk Feb. 1963 187 p
(Contract AF 19(604)-7339)
(AFCRL-63-119(II); AD-421592)

An experimental study of three-body recombination in a dense plasma of helium with a trace addition of argon is reported. The plasma studied was generated by the interaction of high-intensity pulsed-microwave radiation with a static volume of gas confined in a nonresonant waveguide cell. It was found that the recombination coefficient varies linearly with pressure from 4×10^{-10} to 1.7×10^{-8} cm^3/sec over the pressure range 100 to 800 torr. The experimental results are compared with the criteria of Gray and Kerr for distinguishing electron loss by recombination from loss by diffusion. Author

N64-31272 Uppsala U. (Sweden) Inst. of Physics
DAMPING AND POLARIZATION OF PLANE MAGNETOHYDRODYNAMIC WAVES
S. I. Herlitz Jan. 1963 18 p refs
(Grant AF-EOAR-62-109)
(ARL-63-195; AD-420544)

This paper considers the influence of resistive dissipation on the properties of plane, time-harmonic, small-amplitude magnetohydrodynamic waves in a compressible fluid immersed in a homogeneous magnetic field. As the electrical conductivity decreases from infinity to zero, either the fast or slow magnetoacoustic wave transforms to an ordinary sound wave. The description of this transition depends on whether the Alfvén speed is less than, equal to, or greater than the sound speed. The

fluid displacement in the fast and slow waves is, in general, elliptically polarized in a plane parallel to the magnetic field and the wave normal. In some cases the dissipation may have a considerable effect on the polarization of a wave, even though the wave is relatively weakly damped. Author

N64-31282 General Applied Science Labs., Inc., Westbury, N.Y.
BACK-SCATTERING BY A CORRUGATED PLASMA CONFIGURATION-HOMOGENEOUS PLASMA, NORMAL INCIDENCE, LONG CORRUGATION WAVE LENGTH
F. Lane, S. Mariano, and G. Weilerstein 6 Jan. 1964 56 p refs
(Contract NOw-63-0637-C(FBM))
(TR-394; AD-430009)

A previously developed approximate technique for computing the back-scattering from a cylindrical plasma configuration, having arbitrarily large (axisymmetric) radial nonuniformity of electron density and slowly varying axial nonuniformity, is applied to a plasma configuration whose axial dependence is weak in a geometric sense rather than being due to inhomogeneity of plasma density. The method relies upon the use of an axial distribution of multipoles to represent the scattered field. The model has the capability of being exact if the multipole density distribution can be computed exactly. P.V.E.

N64-31316 Innsbruck U. (Austria) Inst. for Theoretical Physics
ONE-DIMENSIONAL UNSTEADY MGD FLOW
Ferdinand Gap and Franz Herrwegger 25 Apr. 1964 13 p refs
(Contract AF 61(052)-675)
(SR-9; AD-447832)

The one-dimensional unsteady (time-dependent) potential equation has been linearized by a Legendre transformation. The resulting differential equation was solved with a characteristics method. Author

N64-31329 Columbia U., New York, N.Y. Plasma Research Lab.
DYNAMICS OF IONIZING SHOCK WAVES: I. TRANSVERSE SHOCKS
C. K. Chu Jan. 1964 43 p refs
(Contract AF 49(638)-1254)
(Rept.-7; AD-601110) OTS: $1.00

A simplified model of ionizing shock waves in a magnetic field is considered. The shocks considered are an intermediate species between gas shocks and hydromagnetic shocks. The gas ahead of the shock is assumed to be a perfect nonconductor, and that behind the shock is assumed to be a perfect conductor. For simplicity, the energy required in the ionization processes is ignored. Also treated are "transverse" shocks, in which the magnetic field is tangential to the shock front and thus is transverse to its direction of propagation. P.V.E.

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-30470* Chicago U., Ill. Labs. for Applied Sciences
QUANTUM EFFICIENCY OF SILICON IN THE VACUUM ULTRAVIOLET
A. J. Tuzzolino repr. from the Phys. Rev., v. 134, no. 1A, 16 Apr. 1964 p A205–A213 refs
(Grant NsG-179-61)

A measurement of the quantum efficiency of silicon has been carried out over the photon energy range from 4.9 to 21.2 ev by measuring the photoresponse of silicon surface-barrier photodiodes. The quantum efficiency increases from 2.0 at $h\nu = 4.9$ ev to approximately 3 at $h\nu = 6$ ev; between $h\nu = 6$ ev and $h\nu \approx 10$ ev, the quantum efficiency is approximately constant and beginning at $h\nu \approx 10$ ev, increases strongly with increasing photon energy, attaining a value of 15 at 21.2 ev. This observed behavior is consistent with qualitative predictions based upon a model for secondary ionization effects in silicon proposed by Shockley and a simplifying assumption as to how the excess energy available following an ionization event is distributed between the original carrier and generated electron-hole pair. Author

N64-30534 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
INJECTION LASER STUDY Quarterly Progress Report, 1 Mar.–31 May 1964
W. P. Dumke, F. Stern, and K. Weiser [1964] 51 p refs
(Contract DA-36-039-AMC-02349(E))
(QPR-4; AD-603651)

A fairly comprehensive computer program has been written for studying the gain and loss characteristics of a wide range of laser structures having layers with different optical properties. Calculations for conventional zinc-diffused injection lasers show that a reasonable optical model can fit the observed loss and the far-field angular distribution perpendicular to the junction plane. A new method for fabricating GaAs laser diodes with P-P°-N structure has been developed. Switching into the lasing state has been achieved at 77° K in the P-P°-N diodes, and from a low-current to a high-current state at room temperature. A theory of the switching speed of P-I-N diodes whose negative resistance arises from light absorbed in the high-resistance region has been given for the limiting cases of high and low external circuit impedance. Author

N64-30548 Goodyear Aerospace Corp., Akron, Ohio
INVESTIGATION OF DIELECTRIC MATERIAL FOR ERECTABLE LENSES Final Report, Jul. 1961–Jun. 1963
W. D. Wise 17 Jun. 1963 51 p refs
(Contract AF 33(616)-8474)
(ASD-TDR-63-780; AD-423436)

Material-structure systems characterized by light weight, a dielectric constant of 3.6 to 4.0, low dissipative loss, and erectability from a compact state in an orbital environment were investigated to implement a concept for a high-gain, passive, nonoriented communications satellite based on covering a large-diameter sphere with thin lens-reflector elements. A lens medium of a random maze of aluminum slivers in a plastic filament was selected as a practical system, and an inflatable element was built, electrically tested, and erected in a simulated orbital environment. Author

N64-30581 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
MEASUREMENTS OF TRUE DARK CONDUCTIVITIES IN FERROCENE CRYSTALS
Edward Zehler and Claire Loscoe May 1964 13 p
(TR-2459; AD-603815)

This report describes systematic dark conductivity measurements on a monomeric organic crystal. The material chosen is ferrocene, a metalloorganic compound, and single crystals were grown from solutions or the melt by the Bridgman technique. Because of its relatively low room-temperature resistivity of the order 10^{13} ohm cm and simple structure, the material appears to be very suitable as a model substance for dark conductivity investigations. From the measurements performed, including four-probe measurements, voltage probing between contacts, guard ring methods, and long-time observations, it can definitely be established that contact effects and dielectric relaxation have a minor effect on the resistance of the sample, provided sufficient time is allowed for the observation, and that a true dark conductivity and activation energy can be determined within a few percent accuracy. Author

N64-30590 Columbia U., New York, N.Y. Columbia Radiation Lab.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTRO MAGNETIC SPECTRUM Sixth Quarterly Progress Report, Mar. 16–Jun. 15, 1964

R. Novick 15 Jun. 1964 75 p refs
(Grants NSG-360; NSG-442; DA-ARO(D)-31-124-G170; DA-ARO(D)-31-124-G380; DA-ARO(D)-31-124-G477 et al
(CU-6-64-SC-90789; AD-603446)

Continuous oscillation has been achieved with an optically pumped Rb^{87} maser. This device oscillates at 6835 Mc/sec, corresponding to the hyperfine splitting of the ground state of Rb^{87}. Population inversion is achieved with intensity pumping, and the gain is enhanced by magnetic shielding. The power output is about 10^{-10} W. The hyperfine coupling constants due to quadrupole, spin-rotation, and spin-spin interaction have been determined for NH_2D in the $3_{13} \rightarrow 3_{03}$ rotation inversion transition by means of beam-maser spectrocopy. Also the hyperfine spectrum in the $3_{03} \rightarrow 3_{13}$ rotation-inversion transition of NHD_2 at 18.48191 Gc has been observed, and calculations are in progress to determine the various coupling constants. A detailed electron nuclear double-resonance (ENDOR) study of the self-trapped hole in LiF has been completed. Author

N64-30591 Corning Glass Works, N.Y.

GLASS LASER RESEARCH Semiannual Technical Report, Jan.–Jun. 1964

M. L. Charters, N. F. Borrelli, P. E. Gordon, and R. D. Maurer 30 Jun. 1964 47 p refs
(Contract Nonr-3833(00))
(AD-443680)

Measurement of relevant physical properties has continued. The technique for measuring absorption loss at 1.06μ has been improved to obtain reliable data from glasses that are not of optical quality. Experimental equipment has been set up to obtain the optical path change with temperature at 1.06μ. The theory of crystal field effects on the fluorescence of Nd^{3+} is examined, and correlation between lifetime and optical absorption pointed out. An analysis is presented of the absorbed energy distribution in a cylindrical laser rod. Author

N64-30596 Naval Radiological Defense Lab., San Francisco, Calif.

ELECTRONIC RELAXATION EFFECT IN THE EMISSIVITY OF METALS

W. J. Parker 2 Jun. 1964 50 p refs
(USNRDL-TR-755; AD-444340)

Equations have been developed for the spectral emissivity of metals as a function of angle and plane of polarization based on the Drude free-electron model, taking the electronic relaxation time into account. These equations were integrated to obtain more general expressions for the total normal and total hemispherical emissivity than previously existed. These are compared with experimental data on the total and spectral emittance of metals. There is a qualitative but not a quantitative agreement. Author

N64-30601 Minneapolis-Honeywell Regulator Co., Hopkins, Minn.

THE MECHANICAL AND MICROMECHANICAL PROPERTIES OF BORON Interim Report, 1 May–30 Jun. 1964

C. J. Speerschneider and J. A. Sartell 14 Jul. 1964 14 p refs
(Contract NOw-64-0159F)
(IR-3; AD-602864)

The orientation of a boron single-crystal rod was determined by the Laue back-reflection technique. Using a Netzsch dilatometer, the coefficient of thermal expansion was found for room temperature to 1,050° C for both single, ⟨111⟩, and polycrystals. In addition, studies of the fracture characteristics of boron have continued. Author

N64-30608* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

HIGH PHOTOVOLTAGES IN SILICON AND SILICON CARBIDE FILMS AND THEIR ORIGIN FROM A TRAP-INDUCED SPACE CHARGE

H. W. Brandhorst, Jr. and A. E. Potter, Jr. Repr. from J. of Appl. Phys., v. 35, no. 7, Jul. 1964 p 1997–2003 refs
(NASA-RP-315)

Photovoltages were observed in thin films of silicon and silicon carbide which were not uniform in thickness. In some cases, the photovoltages exceeded the the band gap. The photovoltages were retained by the film after removal of the light and decayed exponentially with time constants of the order of tens of seconds. The films were capable of acquiring persistent space charges upon application of an external voltage. The space charges decayed exponentially after removal of the applied voltage with time constants similar to that of the decay of the photovoltages. The photovoltages seemed related to the nonuniformity of the film, increasing with increasing nonuniformity. These results were interpreted to mean that the photovoltage is due to a space charge produced by a nonuniform distribution of trapped minority carries, and a mathematical formulation was given to this concept. The temperature, light intensity, and carrier lifetime dependence of the photovoltage were in qualitative agreement with this concept. Author

N64-30642 Centro Brasiliero de Pesquisas Fisicas, Rio de Janeiro

ABSOLUTE CROSS-SECTIONS FOR SOME (n,p), (n, α) AND (n, 2n) REACTIONS

J. M. F. Jeronymo, G. S. Mani, J. Olkovsky, A. Sadeghi, and C. F. Williamson (Centre d'Etudes Nucleaires) 1963 43 p refs
Its Notas de Fisica, v. XI, no. 1

The reactions $Al^{27}(n,\alpha)Na^{24}$, $Mg^{24}(n,p)Na^{24}$, $Si^{28}(n,p)Al^{28}$, $Co^{59}(n,p)Fe^{59}$, $Co^{59}(n,2n)Co^{58}$, $Co^{59}(n,\alpha)Mn^{56}$, $Ni^{58}(n,p)Co^{58}$, and $Ni^{58}(n,2n)Ni^{57}$ have been studied by an activation method from 12.5 to 21.0 Mev neutron energy. A method of calibrating well-type crystals to obtain absolute efficiency is described. The results for absolute cross sections obtained by this method for the above reactions are compared with statistical model calculations in which the nuclear transmission coefficients have been derived from an average optical potential extracted from the scattering data. Author

N64-30676 Naval Research Lab., Washington, D.C. Solid State Div.
ENERGY TRANSFER IN SILICATE GLASS COACTIVATED WITH CERIUM AND NEODYMIUM
H. W. Gandy, R. J. Ginther, and J. F. Weller Jul. 1964 10 p refs
(ARPA Order 306-62)
(NRL-1546; AD-443921)

In a study of doubly activated silicate glass, the energy absorbed by Ce^{3+} is found to transfer to Nd^{3+}, thereby causing the characteristic infrared luminescence of this ion. Both radiative and radiationless energy transfer mechanisms appear to be possible in this glass. Evidence for the existence of the latter mechanism is presented and discussed. Author

N64-30685 Technical Operations Research, Burlington, Mass.
THE INVESTIGATION OF PASSIVE LASER Q-SWITCHING Final Report, 1 Apr. 1963–30 Jun. 1964
J. I. Masters, P. Kafalas, and E. M. E. Murry 30 Jun. 1964 79 p refs
(Contract Nonr-4126(00))
(TO-B 64-54; AD-603115) OTS: $3.00

The passive Q-switching concept is introduced as an application under the general heading of saturable nonlinear optical elements. The bulk of the laboratory investigation reported is concerned with two organic dye materials for use with ruby lasers—Victoria Blue B deposited on a glass substrate and Cryptocyanine used as a solution contained in a suitable cell. The liquid component operates on a nondestructive radiative process that allows repetitive unattended giant pulse. The liquid, however, may be somewhat slower in switching speed than the Victoria Blue B films that are permanently bleached by thermal dissociation at the onset of each giant pulse. For the particular laser system used in this work, both types of passive switching produced giant pulses of peak power essentially equivalent to pulses that can be obtained by electromechanical Q-switching techniques. Author

N64-30690 Massachusetts Inst. of Tech., Cambridge, Lab. for Insulation Research
FLUORESCENCE OF TRANSITION METAL IONS IN CRYSTALS
Baldassare Di Bartolo Jun. 1964 70 p refs
(Contracts Nonr-1841(10); AF 49(638)-1334; Grant AF-AFOSR-62-317)
(TR-190; AD-603459) OTS: $3.00

Magnetic ions in crystals present peaked fluorescence lines whose width and position depend on temperature, as do the fluorescence lifetimes of the excited states. Experiments made evaluate the temperature dependence of line width, line shift, and lifetime of the peaked fluorescence presented by Cr^{3+} and V^{2+} impurities in Al_2O_3 and MgO. The vibronic spectrum associated with the $^2E \rightarrow {}^4A_2$ fluorescence transition at 8,700 A of V^{2+} in MgO has been investigated as a function of temperature. At low temperatures vibrational satellites are observed only on the low-energy side of the pure electronic transition, corresponding to spontaneous phonon emission, while at higher temperatures they are also on the high-energy side, corresponding to phonon absorption. With increasing temperature the vibronic bands become more intense relative to pure electronic transition, the peaks broaden, and multiphonon processes enter that combine to form a broad fluorescence continuum extending from ≈ 7,000 to 10,000A. Author

N64-30702 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FIELD EMISSION OF SILICON
R. Fischer 15 Jul. 1964 5 p refs Transl. into ENGLISH from Phys. Status Solidi (Germany), v. 3, no. 7, 1963 p252–255
(FTD-TT-64-164/1+2; AD-446795)

Calculation of the field-emission current density of silicon cathodes is discussed. The electron concentration on the surface of silicon cathodes was calculated at room temperature for three different electron concentrations in the basic materials. For the cases considered, the current density of the electrons emitted from the valence band was greater than that emitted from the conduction band and the valence band were also calculated. It was found that the energy distributions of emission from the conduction band and the valence band differ in value, as well as in their dependence upon the outer-field intensity. P.V.E.

N64-30706 Catholic U. of America, Washington, D.C.
RESEARCH ON THE APPLICATION OF FERRO- AND FERRIELECTRIC PHENOMENA IN COMPUTER DEVICES
Charles F. Pulvari Wright-Patterson AFB, Ohio, AF Avionics Lab., Oct. 1963 49 p refs
(Contract AF 33(657)-8871)
(RTD-TDR-63-4002; AD-423782)

The objective of this research was to demonstrate that capacitor elements composed of ferrielectrics of the MBO-type (mixed bismuth oxide) employed as a dielectric represent an important improvement as compared to ordinary ferroelectric capacitors and that they can be utilized as a computer logic device. Fabrication techniques of these ferrielectric devices are discussed. Certain applications have been explored, such as the development of field-controlled polarization transfer devices (Transpolarizers). Ferri-resonance flip-flop devices and a shift register using these flip-flops are also presented. A noncontact readout method was investigated utilizing a novel vibrating electrode solid-state electrometer. Author

N64-30709 Isomet Corp., Palisades Park, N.J.
RESEARCH ON A SUITABLE DISPERSING OR ANALYZING CRYSTAL FOR X-RAY SPECTROSCOPY Final Report, 15 Dec. 1961–14 Dec. 1962
Warren Ruderman, Edward Losin, and Dudley Uphoff Wright-Patterson AFB, Ohio, AFSC, Apr. 1963 21 p
(Contract AF 33(657)-7756)
(ASD-TDR-63-311; AD-403492)

A large number of potential compounds were investigated for application as X-ray analyzer crystals with 2d spacings from 25 to 100 A. Four crystals with 2d values from 31 to 90 A were developed, and show exceptional promise. Although large crystals of these compounds were not grown, X-ray analysis of small crys[illegible] indicated excellent reflectivities. Author

N64-30753 Carborundum Co., Niagara Falls, N.Y. Research and Development Div.
INTERSTITIAL COMPOUNDS OF BORON AND TRANSITION METALS. PACKING OF B_{12} GROUPS IN BORON AND BORIDE STRUCTURES
V. I. Matkovich, R. F. Giese, Jr., and J. Economy Jul. 1964 27 p refs Submitted for Publication
(Contract Nonr-4075(00))
(TR-3; AD-443487)

This study is concerned with the establishment of structural properties common to all borides and with modifications

of boron that contain B_{12} polyhedral units. All unit cell dimensions in these structures can be derived from simple arrangements of B_{12} units, which can be regarded as large metallic atoms that form interstitial compounds. The B_{12} units can also group together to form larger units, such as the recently reported B_{84}. These are also treated as individual entities. On this basis all the structures have been classified into three simple packing models—cubic closest packing, hexagonal closest packing, and tetragonal closest packing. Author

N64-30768 Battelle Memorial Inst., Columbus, Ohio
STUDIES IN THE UO_2-ZrO_2 SYSTEM
Thomas R. Wright, Donald E. Kizer, and Donald L. Keller 27 Aug. 1964 38 p refs
(Contract W-7405-ENG-92)
(BMI-1689) OTS: $1.00

Densification and homogenization of compacted ball-milled powders were accomplished by sintering from 10 to 15 hr at 1,700° C or from 15 to 20 hr at 1,600° C in flowing dry hydrogen. Homogeneous fuel pellets with densities in excess of 97% of theoretical were obtained for property studies. The thermal conductivity of the UO_2-50 mole % ZrO_2 composition was found considerably lower than that of UO_2 but higher than that of ZrO_2. The linear-thermal-expansion curve roughly paralleled that of pure UO_2, at a slightly higher value, over the temperature range measured. Electrical resistivity decreased with increasing temperature, as is typical of a ceramic material. In tests of UO_2-20 to 50 mole % ZrO_2 compositions, in general, both room-temperature and high-pressure hardness values increased as the ZrO_2 content increased. Homogeneous UO_2-50 mole % ZrO_2 pellets were more resistant to cracking under thermal cycling than were inhomogeneous pellets of the same composition. Author

N64-30769 Union Carbide Nuclear Co., Oak Ridge, Tenn.
X-RAY FLUORESCENCE TABLES: BARIUM STEARATE CRYSTAL
W. P. Amsbury, W. W. Lee, J. H. Rowan, and G. E. Walden 29 Sep. 1964 197 p refs
(Contract W-7405-ENG-26)
(Y-1470-1) OTS: $3.00

A critical compilation of standard reference tables of X-ray fluorescence lines has been published in convient form for experimental use. This section of the report contains tables calculated for a barium stearate crystal of nominal spacing. Author

N64-30770 Virginia U., Charlottesville
THE EQUILIBRIUM OF CRYSTAL SURFACES
N. Cabrera [1964] 61 p refs
(Contract Nonr-474(05))
(AD-602105) OTS: $3.00

The basic principles underlying the theory of crystal surfaces are reviewed, specifically from the phenomenological thermodynamic point of view. The bulk of the paper is concerned with the equilibrium of crystal surfaces in contact with a vapor. The problem of the surface between two lattices and its role in the epitaxial relationship between them are discussed. A.W.

N64-30771 Delaware U., Newark
ELECTRO-OPTICAL METHOD FOR INVESTIGATION OF FIELD AND CURRENT DISTRIBUTIONS IN SEMICONDUCTORS AND LAYER-LIKE FIELD DISTRIBUTIONS IN PHOTOCONDUCTORS Progress Report, Nov. 15, 1963–Jun. 30, 1964
K. W. Boer [1964] 6 p
(Contract Nonr(G)-00046-63)
(PR-1; AD-603075) OTS: $1.00

Activities involving the following are discussed: (1) building facilities for growth of CdS single-crystal platelets of desired doping and crystal growth; (2) contructing equipment for evaporation of contact layers onto CdS crystals in ultrahigh vacuum; (3) building experimental setups for microscopic investigations of the electroluminescence of CdS single crystals and for preliminary experiments; and (4) building an ac generator at 10 Mc/sec and of up to 2 kV, in order to excite CdS crystals electrically homogeneous and to calibrate actual field distribution in the excited crystals. P.V.E.

N64-30778 Union Carbide Corp., Indianapolis, Ind. Linde Div.
CZOCHRALSKI RUBY Annual Summary Report, 1 May 1963–30 Apr. 1964
O. H. Nestor 8 Jul. 1964 72 p refs
(Contract Nonr-4132(00); ARPA Order 306-62; Proj. Defender)
(AD-443460)

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2. ETCHING OF DISLOCATIONS IN RUBY AND SAPPHIRE, APPENDIX II M. N. Plooster 11 p refs (See N64-30780 22-25)

N64-30779 Union Carbide Corp., Indianapolis, Ind. Linde Div.
REFRACTIVE INDEX VARIATIONS OF RUBY: BEAM DIVERGENCE AND INTERFEROMETRY, APPENDIX I
O. H. Nestor *In its* Czochralski Ruby 8 Jul. 1964 18 p refs Previously issued as Misc. Note 37 (See N64-30778 22-25)

This work was undertaken to establish limits of variation in chromium concentration, crystallographic orientation, and stress within a ruby rod consistent with optical quality requirements for laser applications, and thereby to sharpen crystal growth objectives. The effects of chromium, orientation, and stress on the refractive index of ruby were derived from literature data. The results were used to translate radial variations in these factors into beam divergence produced on one-pass when the variations are such as to distort an incident plane wave into an emergent spherical wave. The index data were also used to establish the relationships whereby Twyman–Green interferograms can be related directly to variations of chromium, orientation, and stress over the rod aperture and to the expected beam divergence in special cases. A parallel treatment of the temperature effect also is included. Author

N64-30780 Union Carbide Corp., Indianapolis, Ind. Linde Div.
ETCHING OF DISLOCATIONS IN RUBY AND SAPPHIRE, APPENDIX II
M. N. Plooster *In its* Czochralski Ruby 8 Jul. 1964 11 p refs (See N64-30778 22-25)

The technique used to develop etch pits at the intersections of dislocations with the surface of a sapphire or ruby crystal is discussed. The overall process comprises a chemical polish with H_3PO_4 at 425° C to remove saw scratches and other surface blemishes, followed by a phosphoric acid etch of the basal (0001) plane at 325° C. The faces of the crystal samples used during etching should be oriented as well as possible. Surfaces

misoriented by as much as 3° from the (0001) plane result in elongated triangular etch pits. A sample misoriented by 6° gives only rounded, elliptical depressions for etch pits. On faces oriented within 1°, however, the etch pits are always shaped like equilateral triangles. P.V.E.

N64-30792* Rice U., Houston
QUENCHED-IN RESISTIVITY IN DILUTE ALLOYS
R. M. Asimow Repr. from Phil. Mag., v. 9, no. 97, Jan. 1964 p 171–175 refs
(Grant NsG-6-59)

A theoretical and experimental investigation was performed on the resistivity changes in a dilute alloy that occur at quenching due to the quenched-in vacancies and due to changes in the short-range order with temperature. Gold–silver specimens containing up to 3 at.% silver and gold–indium specimens with up to 3 at.% indium were tested; the numerical results were not in quantitative agreement with the theory. This disagreement is suggested to be attributable to the large changes in order and vacancy concentration that take place during a high-temperature quench. D.E.W.

N64-30795 Centro Brasileiro de Pesouisas Fisicas, Rio de Janeiro
NUCLEAR ISOMER SHIFT AND COVALENCY IN IRON COMPLEXES
J. Danon 1963 9 p refs *Its* Notas de Fisica, Vol. 10, No. 17 Submitted for Publication

Various studies of the isomer shift in iron complexes are summarized. Based on arguments presented in the summary, it is concluded that the extent of delocalization of 3d electrons and consequent increase in s-electron density at the iron nucleus should be smaller in $Fe^{II}[S_2CN(CH_3)_2]_2NO$ than in $Fe(CN)_5NO$, which conclusion is in agreement with the isomer shift values for these complexes. P.V.E.

N64-30799* New York U., N.Y.
THE PRESSURE-TEMPERATURE DIAGRAM OF SOLID THALLIUM
Philip N. Adler and Harold Margolin Repr. from Trans. Met. Soc. AIME, v. 230 Aug. 1964 p 1048–1052 refs
(Grant NsG-90-60)

Univariant equilibria between the I_{bcc}, II_{hcp}, and III_{fcc} phases of thallium have been determined and indicate a triple point at 110° C and 37 kbars. Calculated II→I transformation curves are compared with the experimental. Transformation volumes and/or enthalpies are calculated, and enthalpies are compared with available data. Author

N64-30802* Field Emission Corp., McMinnville, Ore.
INVESTIGATIONS OF THE MIGRATION, DESORPTION AND VOLTAGE BREAKDOWN PROPERTIES OF CESIUM FILMS ON REFRACTORY ELECTRODES
F. M. Charbonnier, L. W. Swanson, E. C. Cooper, and R. W. Strayer N.Y., AIAA [1963] 50 p refs Presented at the AIAA. ARS Elec. Propulsion Conf., Colorado Springs, 11–13 Mar. 1963
(Contract NASw-458) AIAA: $0.50 members, $1.00 nonmembers

Preliminary results of the migration of cesium at various initial coverages also show many similarities in both the migration temperatures and the effect of substrate crystallographic orientation on the mode of surface migration. Application of a dc electric field of either polarity (ranging from +14 to −22 mV/cm) is found to produce a significant decrease in the activation energy for surface diffusion of cesium on tungsten. A related investigation of the prebreakdown currents between cesium-coated tungsten electrodes, both in high vacuum and cesium pressures of 10^{-6} torr, will be discussed; results of current measurements, at various electrode spacings and at applied voltages up to 13 kV, indicate stable, reproducible field emission as the principal source for the gap currents observed, at least at the voltage gradients investigated (up to 1.2 kV/mil for heavy cesium coverage). Author

N64-30815 Dynatech Corp., Cambridge, Mass.
FEASIBILITY STUDY OF APPLICATION OF SUPERCONDUCTOR TECHNIQUES FOR ROTATING ELECTRICAL GENERATORS Final Report, May 1, 1963–Apr. 31, 1964
R. L. Mela, H. W. Mooncai, C. J. Oberhauser, E. F. Doyle, A. Kusko et al Wright-Patterson AFB, Ohio, Aeropropulsion Lab., May 1964 124 p refs *Its* Rept. No. 472
(Contract AF 33(657)-11062)
(APL-TDR-64-71; AD-603148) OTS: $4.00

A preliminary design study, with some supporting experiments, has been performed of a 1,000-kva rotating electrical generator for space application. The design study included cooling equipment to maintain the device in the vicinity of 10° K, plus ancillary drives and heat-rejection components. Considerable study was devoted to possible machine arrangements, mechanical features of the generator, cooling equipment heat loads, and cooling equipment design. System reliability and startup procedure were also considered. The problem of alternating field losses in superconductors was given considerable attention, and estimates of these losses were made. The weight of the generator–cooling equipment package was found to be about 1/2 lb/kw. Appreciable additional weight saving results from an overall package efficiency in the 98% range. Some reduction in reliability appears inevitable due to inclusion of the cooling equipment. Author

N64-30887 National Engineering Science Co., Padadena, Calif.
SCATTERING OF TRANSIENT ELASTIC WAVES BY A CIRCULAR CYLINDRICAL CAVITY
Julius Miklowitz Kirtland AFB, N. Mex., Res. and Technol. Div., Jun. 1964 70 p refs
(Contract AF 29(601)-5395)
(RTD-TDR-63-3052; AD-603167) OTS: $3.00

Two problems of transient wave scattering from a circular cylindrical cavity in an infinite elastic solid are considered. In the first of these, the cavity wall is subjected to a suddenly applied concentrated line load. In the second, a transient plane compressional wave impinges on the cavity wall. Formal solutions in the form of a series of Fourier integrals are written for both problems by employing a double-integral transform (Laplace for time t, Fourier for circumferential coordinate θ), the integrals representing θ traveling waves governed by particular branches of the underlying frequency equation. In particular, the Rayleigh waves on the cavity surface, corresponding to a limiting high-frequency large wave number pair, are evaluated. They are found to be spatially θ-independent waves, nondecaying, and periodic (2π) in time, which predominate in the long-time solutions, producing sizable disturbances that have not been previously noted and assessed. Author

N64-30898 Radio Corp. of America, Princeton, N.J. Electronic Research Labs.
COMPATIBLE ACTIVE THIN-FILM INTEGRATED STRUCTURES Interim Scientific Report, 15 Jun.–15 Oct. 1963

C. W. Mueller, J. J. Bowe, E. P. Helpert, D. Meyerhofer, and A. Revesz Wright-Patterson AFB, Ohio, Electron. Technol. Div., 15 Nov. 1963 32 p refs
(Contract AF 33(657)-11398)
(ISR-1; AD-425795)

A literature survey is given covering work in the fields of theory of silicon growth, growth of silicon from the vapor phase, evaporation, and thin-film silicon devices. This report is concerned essentially with the first steps in the development of a thin-film integrated circuit, namely the development of the semiconductor substrate and the active device. Two methods of forming the substrate are being investigated—evaporation and pyrolysis. After studying several methods of evaporating, direct electron-beam bombardment of silicon was adopted. A flow system for the pyrolysis of silane was set up along with the desirable doping supplies and tested by growing epitaxially on silicon. About 20 depositions of silicon have been made on polished aluminum-oxide and single-crystal sapphire. Both types of films are examined by X-ray analysis, electron diffraction, electron microscopy, and electrical measurements. Author

N64-30908 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
PHONON INTERACTIONS IN CRYSTALS Quarterly Technical Report, 15 Feb.–14 May 1964
A. H. Nethercot, M. Pomerantz, N. S. Shiren, and I. Tadjbakhsh [1964] 58 p refs
(Contract DA-36-039-AMC-02280(E))
(QTR-4; AD-603447) OTS: $3.00

Additional experimental work has been done on the parametric up-conversion process in a variety of crystals and along different axes. These crystals include MgO, Ge, Al_2O_3, quartz, and CaF_2. These measurements allow an evaluation of the size of the third-order (anharmonic) constants. Theoretical work has also been done on the interrelationships between these collinear forward-traveling-wave processes and the attenuation of microwave acoustic beams by interaction with the thermal phonon distribution. Rather larger interactions between the microwave phonons and the conduction electrons in samples of germanium have been observed. A total change in the attenuation of ~14 db/cm has been observed when the direction of electron current was reversed. Author

N64-30910 Faraday Translations, New York, N.Y.
THE PHOTO EFFECT IN SILVER–OXYGEN–CESIUM PHOTOCATHODES
P. G. Borzyak [1964] 15 p refs Transl. into ENGLISH from Tr. Inst. Fiz., Akad. Nauk Ukr. SSR (Kiev), no. 4, 1953 p 11-27 Sponsored by Army
(AD-600224) OTS: $1.00

An investigation was made of the photo effect, in relation to the optical properties, of dispersed films of silver coated with adsorbed films of cesium, complex oxygen–cesium films, and films of cesium oxide. The results of the experiments lead to the conclusion that the photo effect of the silver particles in a silver–oxygen–cesium cathode plays an important, and occasionally the principal, role in the photoelectric emission of such cathodes. Author

N64-30922 Automation Industries, Inc., Boulder, Colo.
APPLIED RESEARCH TO ESTABLISH INFRARED DETECTION METHODS FOR NONDESTRUCTIVE ANALYSIS OF METALLIC AND CERAMIC STRUCTURES Technical Documentary Report, Jan. 1962–Feb. 1963
D. R. Maley, H. T. Pinnick, and R. J. Barton Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1963 97 p refs For part I see N64-10251 01-23
(Contract AF 33(616)-7725)
(ASD-TDR-62-385, Pt. II; AD-605511)

Emphasis has been on metals. A thermal testing system developed previously was utilized to study material properties through the inspection of heat-transfer rates. Heat introduced into the material establishes a heat-transfer rate that is monitored by infrared radiometric surface-temperature measurements. These temperature measurements are used to indicate certain material properties that have an effect on heat transfer. Properties detected to date are voids, inclusions, unbonding, porosity, coating thickness, alloy percentage, grain size, and lattice deformation by cold working. Author

N64-30938 Malaker Labs., Inc., High Bridge, N.J.
BASIC RESEARCH ON FERROMAGNETIC SUPERCONDUCTORS Final Report, 6 Feb. 1963–5 Feb. 1964
John G. Daunt, James J. Drautman, Charles J. Anderson, and Samuel H. Stern Griffiss AFB, N.Y., RADC, Aug. 1964 94 p refs
(Contract AF 30(602)-2935)
(RADC-TDR-64-188; AD-605444)

The electrical and magnetic properties of several alloys of $EuRu_2$ or $GdRu_2$ with $CeRu_2$ have been measured in the temperature range 1° to 30° K and in applied magnetic fields up to 6 kOe. All samples were prepared by arc melting. One sample of $CeRu_2$ and several of $GdRu_2$–$CeRu_2$ had a low density and exhibited an anomalous behavior. These specimens underwent an incipient superconducting transition and were either paramagnetic or ferromagnetic at temperatures below that of the superconducting transition. The values obtained for T_c and the ferromagnetic Curie temperature were in agreement with literature. All of the europium samples had a high density and had sharp superconducting transitions in which the susceptibility became negative. The value of T_c decreased slowly with $EuRu_2$ concentration, being 4.67° K for a specimen containing 50% $EuRu_2$. Upper and lower critical field values were found for all these samples. Author

N64-30992* Ohio State U., Columbus
LASER MATERIALS: A TUTORIAL REVIEW WITH BIBLIOGRAPHY
James E. Bradley Washington, NASA, Oct. 1964 295 p refs
(Grant NsG-74-60)
(NASA-CR-75) OTS: $4.00

This paper has five tutorial review sections. Crystallography, crystal chemistry, crystal growth, and glass are important topics of discussion in the first four sections. The fifth section deals with the nature of laser ions, and in particular, rare earth and actinide elements. The bibliography is divided into two parts. Part A contains a selected group of reference books, review articles, and bibliographies on subjects related to laser materials. Part B is a partially annotated bibliography of specific references on a group of subjects related to lasers and laser materials. The contents, sources of references, and degree of coverage of each section are given. D.E.W.

N64-31012 * Field Emission Corp., McMinnville, Ore.
BEHAVIOR OF THIN ALKALI METAL LAYERS ON REFRACTORY METAL SUBSTRATES Final Report, 3 Jun. 1963–2 Jun. 1964
L. W. Swanson, R. W. Strayer, C. J. Bennette, and E. C. Cooper [1964] 127 p refs
(Contract NAS3-2596)
(NASA-CR-54106) OTS: $4.00 fs; $0.75 mf

The behavior of thin alkali layers on refractory substrates is being investigated to obtain fundamental knowledge applicable to solution and control of voltage breakdown across vacuum gaps between alkali-coated electrodes. Results are reported in three areas: (1) surface kinetics studies of cesium on tungsten, molybdenum, and rhenium substrates using field-emission techniques and varying temperature, adsorbate coverage, and applied field; (2) investigations of prebreakdown gap currents and electrical breakdown conditions between clean and cesium-coated refractory electrodes as functions of applied voltage, surface electric field, cesium coverage, ambient cesium pressure within the gap, and environmental conditions; and (3) investigation of individual xenon ion sputtering events on clean tungsten, using field ion microscopy. M.P.G.

N64-31039 Northwestern U., Evanston, Ill. Materials Research Center

FOURTH ANNUAL REPORT, 1 MAY 1963–31 JANUARY 1964

[1964] 118 p refs

(ARPA-SD-67)

(AR-4)

A compendium of reports of the various research programs supported by the Advanced Research Projects Agency (ARPA) is presented. Included are research programs involving the following: (1) developing a new approach to the problem of short-range order in binary solid solutions; (2) measuring the changes in the de Haas–van Alphen effect and the magnetoresistance in high-purity single-crystal chromium caused by cooling through the Neel temperature in a magnetic field; (3) changes in the Fermi surface of zinc due to alloying with copper; (4) observation of the magnetoresistance in gray tin; (5) determination of the interior microwave fields of a homogeneous, isotropic sphere of arbitrary radius, electrical conductivity, dielectric constant, and magnetic permeability located in a resonant cavity; and (6) investigation of spinodal decomposition. P.V.E.

N64-31043 HP Associates, Palo Alto, Calif.

INVESTIGATION OF HOT ELECTRON EMITTER Scientific Report No. 8, 1 Apr.–30 Jun. 1964

M. M. Atalla Jun. 1964 27 p refs

(Contract AF 19(628)-1637)

(AFCRL-64-673; AD-447260)

Analysis of the evaporated CdSe films shows that the indium dopant is present in the films at the same concentration as in the source, but that the In is not electrically active, presumably due to compensation. Hall measurements as a function of temperature show activation energies for conduction electron concentration to be from 0.36 to 0.77 eV. CdSe-Pt diodes exhibit linear reverse leakage up to about 2 V, and space-charge limited current in forward bias. Fabrication of hot electron triodes with CdSe is being discontinued. The studies of the attenuation of hot electrons in gold have been completed. The resistivity of thin gold films has been measured, and these data indicate that the value of $L_p = 350$ A is close to that of perfect gold. Author

N64-31045 Stanford U., Calif. Stanford Electronics Lab.

DIFFUSION, SOLUBILITY, AND DISTRIBUTION OF ZINC IN GALLIUM ARSENIDE AND GALLIUM PHOSPHIDE Technical Report No. 5104-1, Jun. 1961–Sep. 1963

Leroy L. Chang Oct. 1963 68 p refs

(Contract AF 33(616)-7726)

(SEL-63-104; RTD-TDR-63-4164; AD-428828)

Radiotracer Zn^{65} was vapor diffused into GaAs and GaP single crystals in closed, evacuated quartz ampoules. The solubilities and diffusion profiles were obtained over the temperature range 700° to 1100° C. The solubility data were analyzed by assuming Zn-GaAs and Zn-GaP to be binary systems and considering the transfer of neutral Zn from the liquid to the solid where some Zn atoms become ionized acceptors. The solubilities and distribution coefficients of Zn in these two semiconductors have been calculated as functions of temperature up to the melting point of the solvents. The experimentally measured diffusion profiles exhibit a steep front for Zn in GaAs above 700° C and for Zn in GaP above 900° C. Application of the Boltzmann–Matano method to these profiles shows that the diffusion coefficient is strongly concentration dependent. Author

N64-31071 Uppsala U. (Sweden)

CRYSTALLITE SIZE DISTRIBUTIONS FROM X-RAY POWDER LINE PROFILES

Vedene H. Smith, Jr. and Paul G. Simpson 15 Jun. 1964 11 p refs *Its* Preprint 118

(Contract AF 61(052)-701)

(SR-13; ARL-64-195; AD-447321)

The distribution of column lengths, $p^{(n)}/N_c$, in a powder sample is given by the relationship $p^{(n)}/N_c = k(A_{n+1} - 2A_n + A_{n-1})/(A_1 - A_{k+1})$ among the Fourier coefficients of the X-ray powder diffraction line shape under the assumption that the total number of columns of length one, two, to k unit cells is negligibly small. This eliminates the necessity for use of the experimentally imperfect coefficient A_0 and is equivalent to Warren's method for elimination of the "hook effect." Author

N64-31085 Naval Ordnance Lab., White Oak, Md.

THE THERMAL CONDUCTIVITY, THERMOELECTRIC POWER, AND THE ELECTRICAL RESISTIVITY OF STOICHIOMETRIC TiNi IN THE 3 TO 300° K TEMPERATURE RANGE

J. F. Goff Oct. 1964 37 p refs

(NOLTR 64-76; AD-447575)

The thermal conductivity, thermoelectric power, and the electrical resistivity of some stoichiometric TiNi samples and alloys containing Cu and excess Ni have been measured in order to explore the lattice component of the thermal conductivity. It was found that the low-temperature phonon mean-free-path is independent of temperature, depends upon solute species, and increases with solute concentration. In addition the ideal component of the electrical resistivity shows the T^2 dependence below 100° K found for the element Mn and for alloys with this same electron number. Values of the fermi energy, effective mass, and the relative valence of the solutes are derived. Author

N64-31108 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ULTRAHIGH VACUUM APPARATUS FOR THE PREPARATION AND THE STUDY OF THE ELECTRICAL PROPERTIES OF THIN METAL LAYERS

Jaroslav Paces and Pavel Suda 24 Aug. 1964 11 p refs Trans. into ENGLISH from Cesk. Casopis Fys. (Prague), v. 13, no. 4, 1963 p 272–277

(FTD-TT-64-347/1+2; AD-447483)

Described is an ultrahigh vacuum apparatus with mercury diffusion pumps in which a pressure of 3.10^{-11} torr is attained and in which metallic films can be deposited at a pressure of

5.10^{-9} torr or more. The apparatus is intended for the measurement of the electrical properties of thin ferromagnetic layers without the removal of the latter from the vacuum stage.
Author

N64-31114 Microwave Electronics Corp., Palo Alto, Calif.
STUDY OF MICROWAVE GENERATION UTILIZING DOUBLE-STREAM INSTABILITIES IN ANISOTROPIC MEDIA Quarterly Progress Report, 1 May–31 Jul. 1964
F. A. Olson and L. D. Buchmiller [1964] 33 p refs
(Contract DA-36-039-AMC-03424(E))
(Rept.-3; AD-447400)

A large number of pyrolytic graphite samples have been tested for possible low-frequency oscillations during the application of a large pulsed E-field in the basal plane of the material. Oscillations have been observed in the frequency range of 25 to 1,700 Mc/sec. However, some of the lower frequency oscillations have been found to be spurious. Oscillations at 440, 1050, and 1,655 Mc/sec that appear to be due to the PG sample have been observed in zero magnetic field for pulsed E-fields across the sample in the range of 130 V/cm. The corresponding carrier drift velocities have been calculated to be on the order of 4.5×10^6cm/sec. These velocities are in the range where double-stream interaction is feasible. Author

N64-31118 David Sarnoff Research Center, Princeton, N.J.
HIGH FIELD TRANSPORT IN INSULATORS Interim Technical Report, Feb. 28, 1963–Feb. 27, 1964
P. Mark and A. Rose 27 Feb. 1964 19 p refs
(Contract DA-31-124-ARO(D)-84)
(AROD-4017-4; AD-446518)

Work is reported on space-charge-limited current flow, double injection, and field emission from electrodes and from surface states. Possible experimental techniques for avoiding spurious currents are outlined under the use of electrolyte contacts, the use of point contacts, the use of constructions to obtain high fields without space-charge injection, and the use of electrode-free surfaces. The theories of high field transport are reexamined and include a restatement of the various mechanisms for energy loss by fast electrons in elementary physical terms and a demonstration of a close physical connection between the various acoustoelectric effects and the problems of energy loss by hot electrons. Author

N64-31121 General Electric Co., Syracuse, N.Y. Electronics Lab.
AROMATIC ORGANIC LASER DEVELOPMENT Semiannual Report, Jul. 1–Dec. 31, 1963
W. R. Mallory, R. A. Shirk, and D. L. Stockman [1964] 46 p refs
(Contract Nonr-4135(00); ARPA Order 306-62; Proj. Defender)
(AD-429409)

The purpose of this program has been to produce coherent stimulated emission in the blue–green region in a purely organic dopant and host system. Toward this end, a theoretical analysis of the problem was made, and experimental work on the development of such a laser was done. The theoretical analysis indicates that the short-lived ($\tau \sim 10^{-8}$ seconds) four-level fluorescent compounds are the most suitable materials for this purpose. The principal experimental difficulties have included the development of a suitable host material in which the absorbing and scattering losses are kept to a minimum and an optical pump system capable of efficiently producing several megawatts of absorbable peak power in a short time. Some gain at 4710 A in a Fabry–Perot resonant cavity has been observed, which is probably preoscillation "superradiance." Author

N64-31122 General Electric Co., Syracuse, N.Y. Electronics Lab.
AROMATIC ORGANIC LASER DEVELOPMENT Semiannual Report, Jan. 1–Jun. 30, 1964
W. R. Mallory, R. A. Shirk, and D. L. Stockman [1964] 16 p refs
(Contract Nonr-4135(00); ARPA Order 306-62; Proj. Defender)
(AD-444962)

Spectroscopic measurements are reported on perylene and 9-aminoacridine, including absorption and emission curves. A new polymerization catalyst is reported for casting of polymer rods. This catalyst is α,α'-azodiisobutyronitrile. Samples were grown in oxygen evacuated pyrex tubes following a certain temperature cycle for stress optical measurements. Stress-optical coefficient measurements are planned for modified polymethylmethacrylate. A pressurized switch is being tested for use in the optical pump to produce 1-microsecond pulses of 100-Mw peak power. D.E.W.

N64-31124 Colorado State U., Fort Collins Engineer Research and Development Labs.
STUDIES, RESEARCH AND INVESTIGATIONS OF THE OPTICAL PROPERTIES OF THIN FILMS OF METALS, SEMICONDUCTORS AND DIELECTRICS Semi-Annual Report, 16 Feb.–15 Aug. 1964
Charles H. Sheddy (M.S. Thesis) and Lawrence N. Hadley Aug. 1964 87 p refs
(Contract DA-44-009-ENG-3828)
(SAR-10; AD-446632)

Subjects discussed include the theory and quality of films, back-surface measurements, methods of measuring optical constants, surfaces of films, previously reported optical constants of silver, tin, indium, tellurium, antimony, and cadmium, O'Bryan's method for measuring principal angles and its application, the methods of evaporation of films, and results of measurements on the six metals. D.E.W.

N64-31131 Arizona State U., Tempe
OXIDE SEMICONDUCTOR MATERIALS AND DEVICE RESEARCH Quarterly Progress Report 18 Feb.–17 May 1964
F. L. English, C. J. Kevane, J. J. Morrison, B. M. Warmkessel, and H. B. Whitehurst [1964] 21 p refs
(Contract DA-36-039-SC-89151)
(Rept.-10; AD-446208)

Further studies have been made of the short-term variation in resistance of semiconducting rutile. Samples of the material that have been heated at temperatures up to 400° C for periods of less than one minute show a marked decrease in specific resistivity. It has been shown for both single crystals and polycrystalline material that after samples have been cooled to room temperature, or below, the resistivity approaches an equilibrium value over a period of several hours. It has been demonstrated that the time constant characteristic of the approach to equilibrium for a sample of semiconducting single-crystal rutile is more than ten times as great at 2.3° C than it is at room temperature. Measurement of the Hall effect in a sample of partially reduced ceramic rutile has shown that the electron concentration in the sample also shows a time-dependent decreasing trend toward equilibrium at room temperature.
Author

N64-31134 Massachusetts Inst. of Tech., Cambridge
ELECTRONIC STRUCTURE OF POLYATOMIC MOLECULES Final Report, May 1, 1962–Apr. 30, 1964
J. C. Slater 31 Jul. 1964 12 p refs
(Contract AF 19(628)-356)
(AFCRL-64-458; AD-444271)

Progress in the calculation of the electronic structure of polyatomic molecules is described. This includes the preparation of a system of programs called the Polyatom system, which makes it possible to specify the types of atoms and their positions in a polyatomic molecule, and which then proceeds to compute the various molecular integrals required for solving the quantum-mechanical problem of the electronic structure of this molecule, to combine these integrals in a suitable way, and to end up with a calculation of the electronic wave function. Applications of early versions of this method to the structure of benzene and of ethylene are described, and examples of more complicated molecules are described. Author

N64-31142 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
CHELATE LASERS Semiannual Summary Technical Report, 1 Apr.–30 Sep. 1963
A. Lempicki, H. Samelson, and C. Brecher 30 Oct. 1963 22 p refs
(Contract Nonr-4134(00); ARPA Order 306-62; Proj. Defender)
(TR-63-052.2; AD-422363)

Research directed toward obtaining a better understanding of the processes involved in an europium benzoylacetonate (EuB) laser is discussed. The research is divided into two main areas: (1) investigation of the processes leading to the generation of laser oscillation—absorption and optical pumping, mechanism of energy transfer, and the fluorescence in the europium ion; and (2) investigation of the nature of the output—divergence, power, mode structure, and monochromaticity. Discussed in detail are the preparation of europium benzoylacetonate, spectroscopic properties of EuB, energy transfer, optical pumping, the laser configuration, output beam, and output energy and peak power. P.V.E.

N64-31166 Naval Ordnance Lab., Corona, Calif. Research and Development Lab.
HALL EFFECT INVESTIGATIONS Fourth Quarterly Progress Report, 1 Apr.–30 Jun. 1963
H. H. Wieder and A. R. Clawson 15 Sep. 1963 28 p refs
(NAVWEPS-8167; AD-421033)

Thin films of indium antimonide, vapor deposited on oxide-coated surfaces of aluminum or tantalum, offer an advantage in the fabrication of thin-film Hall generators because of the superior thermal conductance between the film and substrate. The deposition and recrystallization of InSb films on oxide–metal substrates have been investigated in detail. Additional studies on the magnetic circuit associated with Hall generators are described, and flux concentrator problem is treated empirically. Author

N64-31189 Bausch and Lomb, Inc., Rochester, N.Y.
INFRARED COATING STUDIES Quarterly Report, 15 Jun.–15 Sep. 1963
L. Chang and A. F. Turner [1963] 31 p
(Contract DA-44-009-AMC-124(T))
(QR-2; AD-422154)

Dispersion relations of the LiF films are strongly dependent on the temperature of the substrate during deposition. Accordingly, calculations have been carried out for four different deposition temperatures. High index films of index 2.7 (ZnTe) and of 3.8 (Ge) were assumed in the reflectance enhancing coating, singly or in combination with a low index film of index 1.8 ($PbCl_2$). These calculated spectrophotometric reflectance curves are given. Results are given of preliminary calculations of reststrahlen-enhancing coatings designed to suppress the reflectance side bands on the short wavelength side. A short statement is presented of the experimental work in progress on enhanced reststrahlen films of LiF. Author

N64-31191 Westinghouse Electric Corp., Baltimore, Md. Air Arm Div.
DEVELOPMENT OF MILLIMETER AND SUBMILLIMETER MASER DEVICES Interim Technical Report, 1 Jun.–30 Sep. 1963
W. E. Hughes [1963] 31 p refs
(Contract AF 33(657)-10472)
(ITR-2; AD-420560)

This report is devoted to operation of a maser using harmonic coupling to establish inversion; studies of new materials—Fe^{3+} in $ZnWO_4$ and Cr^{3+} in $CaWO_4$; establishing a test facility at Wright Field; relaxation rate measurements for Fe^{3+} in TiO_2; and 150 Gc maser pumping configurations. Author

N64-31204* Stanford U., Calif.
A THEORETICAL AND EXPERIMENTAL STUDY OF A SUPERCONDUCTING MAGNETICALLY-SUPPORTED SPINNING BODY
Roger D. Bourke Washington, NASA, Oct. 1964 135 p refs
(Grant NsG-133-61)
(NASA-CR-108) OTS: $2.75

The forces on a magnetically supported body are calculated and compared to experimentally observed values. A method is presented for calculating the magnetic field and forces on the surface of a diamagnetic body in the field of one or more axisymmetric coils. The force and field effects of a small deviation from the nominal axial symmetry are derived. The results of the field calculations are used in the equations of motion to predict the behavior of a supported superconducting spinning body. Experimental apparatus and techniques used in achieving temperatures necessary for superconductivity (4° K) are described. Details of the rotor, coils, spin-up system, and instrumentation are given. A description of the procedure used in operating the system is given. Author

N64-31211* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR MODULATION EFFECTS ON THE PRIMARY COSMIC RADIATION NEAR SOLAR MINIMUM
V. K. Balasubrahmanyan and F. B. Mc Donald Repr. from J. Geophys. Res., v. 69, no. 15, 1 Aug. 1964 4 p refs
(NASA-RP-330)

Previous measurements of the primary cosmic-ray charge and energy spectra did not include the periods just before and during solar minimum. In order to cover this interval during the current solar cycle, a new series of balloon flights using an improved version of the Cerenkov scintillation counter has been initiated. This paper deals with the measurements obtained on a Skyhook balloon flight, in June 1963, of the differential H and He nuclei in the interval 100 to 600 MeV/nuc, the integral H and He flux > 600 MeV/nuc, and the cosmic-ray charge spectra in the range Z = 1 to 8. These measurements occur at a time of decreasing solar activity, some 18 months before solar minimum. E.K.R.

N64-31229 General Electric Co., Syracuse, N.Y. Electronics Lab.
RESEARCH ON THIN FILM INSULATORS

J. M. Blank, S. W. Ing, V. A. Russell, and W. L. Willis Wright-Patterson AFB, Ohio, ASD, 31 Jan. 1964 38 p refs
(Contract AF 33(657)-11079)
(IER-3; AD-447850)

The investigation of electron emission into vacuum from metal-insulator-metal thin-film structures was extended to include both Al-SiO_2-Al and Al-Al_2O_3-Al in thicknesses varying from 20 to a few hundred angstroms. It was found that the very thin samples did not produce emission current but samples as thick as 1000 A gave emission currents with very high transfer fractions. A study of the conduction in films at low temperatures (80° to 300° K) was carried out. A number of samples were found in which the conductivity did not change appreciably over this temperature range. It was also found that the activation process in our films is considerably reduced at low temperatures. The I-V characteristics of Al_2O_3 and SiO_2 films are discussed and compared to theoretical curves with regard to a possible tunneling mechanism. Author

N64-31230 Horizons Incorporated, Cleveland, Ohio
THE FORMATION OF FUNCTIONAL CIRCUIT UNITS BY CATHODOLYSIS Interim Technical Progress Report, 4 Jun.–3 Sep. 1963
R. A. Fotland and J. M. Hlavin Sep. 1963 70 p ref
(Contract AF 33(600)-41705)
(AFSC-TR-7-857 (V); AD-421427)

Special equipment for evaluating components produced by cathodolysis was designed, built, and tested. The use of silicone fluid for forming dielectric films was investigated and found to be superior to dielectric films formed with unsaturated aromatics. Attempts to fabricate thin-film field-effect transistors from CdS, CdSe, and Ge were unsuccessful. Tungsten resistors with sheet resistivities ranging from 200Ω to 200 kΩ were prepared utilizing $W(CO)_6$ vapor. A satisfactory design for a multivibrator was carried out. Author

N64-31247 Naval Ordnance Lab., White Oak, Md.
DETERMINATION OF THE ENERGY OF A PULSED LASER BEAM BY TRANSFER OF THE PHOTON MOMENTUM TO A BALLISTIC TORSIONAL PENDULUM
M. Stimler Oct. 1963 82 p refs
(NOLTR-63-82; AD-420469)

An instrument has been designed and constructed that is capable of measuring high energies of pulsed laser beams, without seriously interfering with their simultaneous use in an experiment. Transfer of the photon momentum of the beam to angular momentum of a doubly reflecting ballistic torsional pendulum was the principle by which photon momentum effects were successfully measured. The instrument operates at 10^{-5} mm of Hg with a sensitivity of 2.55 ±0.04 cm/joule, and does not require damping of the initial oscillations before making a measurement. It provides the capability of simultaneous energy measurement and use of a laser beam, and measurements made with this instrument appear to be more accurate than those made with a commercial calorimeter that was used for comparison. Author

N64-31255 Westinghouse Electric Corp., Baltimore, Md. Air Arm Div.
RESEARCH ON MILLIMETER FERROMAGNETIC TYPE PARAMETRIC AMPLIFIER Sixth Quarterly Progress Report, 1 May–31 Jul. 1963
Robert A. Moore and John D. Cowlishaw [1963] 28 p refs
(Contract DA-36-039-SC-89071)
(Rept.-10; AD-419974)

A major effort has been directed toward finding a dielectric with suitably low-loss characteristics for construction of 4-mm resonant structures. Additionally, the dielectric constant should be approximately that of the ferrite to provide minimum discontinuity. Resonators of $MgTiO_3$ ceramic constructed for 4 and 8 mm have been tested with Q's ranging approximately from 600 to 1,700, the indicated loss tangent being about 0.001 at 4 mm. Because $MgTiO_3$ is a ceramic, diamond tools are required for cutting and shaping. Small spherical cavities, a few mils across, can be cut by sandblasting, then shaped accurately by a soft metal tool cut to size using abrasive powder. To establish ferrite rod properties, the cutoff characteristics of the zero order modes are investigated in detail. It has been established that one mode is H-like and one is E-like. The former is most suitable for parallel pumping. Author

N64-31286 National Carbon Co., Parma, Ohio Research Lab.
RESEARCH TO DETERMINE THE MECHANISMS CONTROLLING THE BRITTLE-DUCTILE BEHAVIOR OF REFRACTORY CUBIC CARBIDES Progress Report, Jan. 1–Apr. 30, 1963
Wendall S. Williams and Robert G. Lye 15 May 1963 48 p refs
(Contract AF 33(657)-10109)
(PR-1; AD-447853)

A fundamental study of the ductile–brittle behavior of the transition metal cubic carbides has been initiated through an investigation of the plastic deformation of single crystals of titanium carbide. A vacuum furnace was designed, built, and used with an Instron testing machine for compression measurements in the temperature range 800° to 1,600° C. The specimens used were Linde single-crystal boules of TiC, cleaved into bars approximately 1 mm × 1 mm × 4 mm. The compressive stress was applied longitudinally in a <100> direction in the NaCl structure of TiC. Results were obtained for the influence of several variables on the yield stress. The variables studied were temperature, composition (x in TiC_x), surface condition, and strain rate. A review was made of the literature on certain physical properties of the carbides, including magnetic susceptibility and soft X-ray absorption. Author

N64-31305 Stanford Research Inst., Menlo Park, Calif.
THERMOELECTRIC MATERIALS Final Report, 8 Apr. 1963–8 Jun. 1964
J. W. Johnson 8 Jun. 1964 20 p ref
(Contract NObs-88487)
(AD-604984)

A study of the resistivity and Seebeck coefficient of liquid inorganic sulfide systems is summarized. The following systems were considered: bismuth-sulfur, bismuth sulfide–cuprous sulfide; cuprous sulfide–cuprous phosphide, and cuprous sulfide–lead sulfide. Conclusions resulting from the study included the following: (1) The operating temperature of p-type liquid cuprous-sulfide-based systems for thermoelectric power generation can be lowered by the addition of bismuth sulfide or lead sulfide. (2) An n-type liquid of Cu_2S can be produced by increasing the Bi_2S_3 or PbS concentration with respect to the cuprous-sulfide concentration. (3) The addition of sulfur to liquid bismuth does not alter the resistivity and Seebeck coefficient of the metal significantly until a concentration near 50 at.% sulfur is attained. (4) Although only a 50–50 mole percent composition in the Cu_2S-Cu_3P system was investigated, it may be postulated by analogy with the Cu_2S-Cu_2Te system that the effect of a change in anion concentration will not be as great as the effect of a change in cation concentration. P.V.E.

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-30487 Aerochem Research Labs., Inc., Princeton, N.J.
RESEARCH IN THE CHEMI-IONIZATION PROCESSES IN THE INTERACTION OF MISSILE EXHAUST PRODUCTS WITH ATMOSPHERIC CONSTITUENTS AND DETECTABILITY OF SUCH PROCESSES BY RADIO FREQUENCY SOUNDING Final Report
A. Fontijn Jul. 1964 38 p refs
(Contract AF 19(628)-3302; ARPA Order 42)
(AEROCHEM-TP-98; AD-443559)

The upper atmospheric modification of rocket exhaust interaction with radar is briefly discussed. It is stated that a probable cause of this phenomenon is the production of free electrons due to chemi-ionization in oxygen-atom reactions with hydrocarbons. The results of a laboratory study program are described; the goal was to further elucidate the mechanism of upper atmospheric chemi-ionization and to obtain quantitative information on chemi-ion production. These chemi-ionization reactions

$$CH + O \rightarrow CHO^+ + e^-$$
$$CH^* + O \rightarrow CHO^+ + e^-$$
$$CH^* + \begin{pmatrix} C_2H_2 \\ \text{or} \\ C_2H_4 \end{pmatrix} \rightarrow \begin{pmatrix} C_3H_3^+ \\ \text{or} \\ C_3H_5^+ \end{pmatrix} + e^-$$

were found to be important. Dominant reaction mechanisms and techniques of finding them are discussed. D.E.W.

N64-30525* Thiokol Chemical Corp., Denville, N.J. Reaction Motors Div.
INVESTIGATIONS OF SPACE STORABLE PROPELLANTS First Interim Summary Report, Mar. 1963–Jan. 1964
M. Luperi [1964] 123 p
(Contract NAS3-2553)
(NASA-CR-58800; RMD-6028-F) OTS: $4.00 fs; $1.00 mf

Ablative cooling for high-combustion-temperature propellants was investigated experimentally in 150-lb-thrust chambers using OF_2 and B_2H_6 propellants with a variety of state-of-the-art ablative material combinations. Ablative materials were shown to behave in a predictable manner with OF_2/B_2H_6. Sea-level injector evaluations conducted at the 2,000-lb (space thrust) level demonstrated that OF_2/B_2H_6 delivers high specific impulse (99% of predicted sea-level shifting equilibrium) over a wide mixture ratio range. Four types of injectors (mid-diameter vortex, full-diameter vortex, coaxial showerhead, and impinging stream) were tested. High performance was obtained with all injectors except for the impinging stream type. Reliable hypergolic ignition of OF_2/B_2H_6 was demonstrated at sea level and at altitude conditions over extreme ranges of environment, operating conditions, and propellant states. Author

N64-30544 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ACTUAL PROBLEMS IN THE FIELD OF FUELS FOR TURBINE JET ENGINES
Boleslawa Mielnik 28 Jul. 1964 19 p refs Transl. into ENGLISH from Tech. Lotnicza (Poland), no. 1, 1963 p 2–7
(FTD-TT-64-349/1+2; AD-446791)

The components of various types of Soviet and United States jet fuels are discussed. Changes over the years in the composition of these fuels are indicated, and the reasons for these changes are discussed. P.V.E.

N64-30554 Pennsylvania State U., University Park
SPONTANEOUS IGNITION DURING CHARGING PROCESSES IN PNEUMATIC AND HYDRAULIC SYSTEMS
G. M. Faeth and W. E. Meyer Oct. 1963 152 p refs
(Contract NObs-78674)
(AD-602888)

This report deals with the ignition of hydraulic fluids by means of compression processes caused by rapid pressurization of air-filled portions of hydraulic and pneumatic systems. A theoretical analysis of the gas temperatures attained during the compression process is presented. Employing this analysis, a reasonable correlation was obtained between the experimental conditions under which ignition would occur during a compression process and the spontaneous ignition temperatures of the hydraulic fluid. Further analytical studies were made of the parameters that affect the rate of compression during rapid venting of high-pressure air or liquid into a pipe containing air at low pressure. The predicted pressure rise rates and maximum pressures were found to be in fair agreement with the experimental results. Author

N64-30556 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency
THE HANDLING AND STORAGE OF LIQUID PROPELLANTS
Neil I. Safeer Washington, Office of the Director of Defense Res. and Eng., Jan. 1963 347 p refs
(AD-442849) GPO: $1.75

This manual is intended for use as a basis for the preparation of regulations governing the handling of liquid-propellant fuels and oxidizers. Instructions are given for the following: personnel training and supervision; the construction and installation of electrical and lightning-protection systems; elimination or reduction of static electricity; prevention of fire, explosion, and health hazards; safety measures; storage; transfer procedures; and disposal and decontamination. Regulations are given for the following propellants and oxidizers: the alcohols, alkyl boranes, anhydrous ammonia, aniline, chlorine trifluoride, ethylene oxide, fluorine, hydrazine, hydrocarbon fuels, liquid hydrogen, hydrogen peroxide, monomethylhydrazine, fuming nitric acids, liquid nitrogen, nitrogen tetraoxide, liquid oxygen, pentaborane, perchloryl fluoride, inert pressurizing gases, normal propyl nitrate, and asym-dimethylhydrazine. I.v.L.

N64-31048 Naval Ordnance Lab., White Oak, Md. Physical Chemistry Div.
SOLID-PROPELLANT ROCKET IGNITION RESEARCH Final Report
C. F. Sharn et al Sep. 1964 114 p refs
(NOLTR-64-107; AD-448068)

A theoretical and experimental study was made of solid rocket ignition for the purpose of obtaining igniter design criteria. Heat-transfer, ballistic, and ignition data were obtained by firing a rocket-type igniter, venting noncondensable products at an unsteady rate, into a small rocket. Measurements were made of igniter and rocket pressures, grain surface temperatures, and ignition times. In the tests, the heat fluxes ranged from 19 to 48 cal/cm^2-sec, and ignition times from 0.002 to 0.015 sec. It was found that the ignition test data were in fair agreement to those predicted from the von Elbe ignition theory. An igniter design method, developed from the test data and the von Elbe theory, is described. Author

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-30468 Technische Hochschule Stuttgart (W. Germany) Arbeitsgemeinschaft für Raketentechnik und Raumfahrt
A RADIAL DIAPHRAGM SEPARATED INJECTION METHOD FOR VARIABLE THRUST LIQUID ROCKET ENGINES WITH OR WITHOUT MIXTURE RATIO VARIATION [EINE RADIALE, MEMBRANGETKENNTE EINSPRITZMETHODE FUR FLUSSIGKEITSRAKETENTRIEBWERKE MIT VARIABLEM SCHUB UND/ODER VARIABLEM MISCHUNGSVERHALTNIS]
Lutz T. Kayser [1964] 13 p Presented at the XVth Intern. Astron. Congr., Warsaw, 7–12 Sep. 1964 In GERMAN; ENGLISH summary
(AGRR-TB-11)

A preliminary survey is given on the development and first experimental investigations of a new injection method. It was found theoretically and shown experimentally that a very good thrust variability with constant mixture ratio and a sufficient combustion stability is achievable with the proposed injection system. A special configuration of a radially cavitating Venturi for mass flow control has been developed for the system and is described. Author

N64-30473 Electro-Optical Systems, Inc., Pasadena, Calif.
APPLIED RESEARCH ON CONTACT IONIZATION THRUSTER. VOLUME II: MISSION ANALYSES Final Report, Mar. 1963–Mar. 1964
Ron S. H. Toms Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., May 1964 167 p refs
(Contract AF 33(657)-10980)
(APL-TDR-64-52, Vol. II; AD-601187) OTS: $3.00

Possible early applications of ion thrusters were investigated to give direction to the advancing technology in thrusters and associated power conditioning, control, and feed systems. Approximate methods of calculating performance and first-order space flight mechanics have general application to a wide variety of low-thrust studies. An exhaustive survey of thrusting modes was performed, using the new techniques. Missions using solar-electric power and nuclear-electric power were considered. It was concluded that the most attractive application for solar-electric rockets is the 24-hour satellite. For the nuclear-electric rocket, an advanced orbital space station, a group of unmanned probes, and all manned missions beyond the moon are highly competitive. Author

N64-30533 Hiller Aircraft Corp., Palo Alto, Calif. Advanced Research Div.
INVESTIGATION OF MINIATURE VALVELESS PULSEJETS Summary Report
R. M. Lockwood and W. G. Patterson Ft. Eustis, Va., Army Transportation Res. Command, Feb. 1964 76 p refs
(Contract DA-44-177-TC-688)
(ARD-307; TRECOM-TR-64-20; AD-604028)

Eleven sizes and configurations of miniature valveless pulsejets were built and tested to determine performance and operational characteristics. When combined with ejector-type intermittent jet thrust augmenters, the best performance was achieved with the HH-M1 pulsejet with augmenters, which produced 17-lb thrust with a Tsfc of 1.8 and a thrust augmentation ratio of 1.9. Thrust-to-combustor volume ratio for this basic pulsejet was 140 lb/ft^3. With augmenters and enclosing shroud, the complete engine package would produce 20 lb/ft^3. Thrust-to-weight ratios approached 12 to 1. Author

N64-30563 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency
PROCEEDINGS OF THE SIXTH MEETING OF THE ICRPG WORKING GROUP ON DESIGN AUTOMATION
Nov. 1963 16 p refs Meeting held at NASA. Langley Res. Center, Hampton, Va., 7 Nov. 1963
(Contract NOw-62-0604-c)
(CPIA-Publ-35; AD-602882)

Abstracts concerning the following are presented: (1) solid rocket-propulsion-system optimization study; (2) generalized three-dimensional grain design program; (3) program integration committee report; (4) performance subcommittee report; (5) design subcommittee report; (6) evaluation subcommittee report; and (7) program inventory committee report. Also presented is a list of publications and schedules. P.V.E.

N64-30760 Brown Engineering Co., Inc., Huntsville, Ala.
THE PRINCIPLE OF OPERATION AND APPLICATIONS OF A SKIMMER NOZZLE
A. Lucile Cox Mar. 1964 31 p refs
(TN-R-90; AD-443068)

The principle of operation of a skimmer nozzle and reported studies with such a configuration are described. The development of a condensation colloidal ion source, which incorporates a skimmer nozzle, is presented. The requirements are cited for such a colloidal ion source to serve efficiently in an electrostatic propulsion engine or as a high-voltage, charge-transport power converter. The possibility of utilizing the skimmer nozzle technique for synthesis of unusual chemical substances, cluster ions, or charged bodies is also examined. Possible improvements in the performance of chemical or nuclear rocket engines operating with a skimmer nozzle are discussed. Author

N64-30965 Philco Corp., Blue Bell, Pa. Research Labs.
AN INVESTIGATION AND DEVELOPMENT OF FILM-PROTECTED, CONVECTIVELY COOLED NOZZLES Second Quarterly Technical Report
R. L. Mitchell, H. L. Moody, A. M. Saul, and W. L. Smallwood 20 Aug. 1964 68 p refs
(Contract AF 04(611)-9705)
(RPL-TDR-64-124; U-2736; AD-604523)

Presented is a summary of the analytical and experimental effort to investigate and develop a film-protected, convectively cooled nozzle for advanced solid-rocket applications. The work performed included thermochemical analyses of the reactions encountered in the boundary layer between the injectant, the free stream, and the nozzle wall; heat-transfer analyses on alumina particle radiation and convection heat transfer to the nozzle wall; fluid mechanics analysis of injection into a turbulent boundary layer with accelerating flow; cold-flow laboratory experiments on injection into a turbulent boundary layer through discrete holes; and rocket motor tests of the cooling concept on a solid-propellant simulator. Author

N64-31010* General Technology Corp. Torrance, Calif.
MAGNETIC INDUCTION PLASMA ENGINE Summary Report
Lee Heflinger and Allan Schaffer 10 Jun. 1964 53 p
(Contract NAS3-3566)
(NASA-CR-54063) OTS: $3.00 fs; $0.50 mf

Experimental performance of an induction plasma engine shows a strong accelerative coupling between magnetic field and high-density plasma. The engine consists of a constant

phase velocity 450-G magnetic field oriented perpendicular to the axis of a 4.6-cm-diam propulsion tube and powered by a megawatt-level 480 kc oscillator. The engine runs at a steady state without preionization during 1.25 msec runs. About 200 kW of power have been transferred to a helium plasma. Thrust exerted on the drive coils and the propellant flow rate reveal that approximately half of the 200 kW is supplied to the plasma as directed kinetic energy, the other half as disordered energy. This performance approaches one theoretical limit for a constant phase velocity accelerator. However, at present approximately half of the power and thrust supplied to the plasma are in turn lost to the tube walls. A program to alleviate plasma wall interactions is suggested Author

N64-31011* Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
ELECTROTHERMAL ENGINE RESEARCH AND DEVELOPMENT, PHASE I Summary Report
20 Jul. 1964 135 p refs
(Contract NAS3-4101)
(NASA-CR-54104; RAD-TR-64-32) OTS: $4.00 fs; $0.75 mf

A 3-kW resistojet thrustor based on a wire-coil heat exchanger was developed. In a 293-hr endurance test the thrustor used a propellant flow rate of 0.065 g/sec of hydrogen and produced a specific impulse of 840 sec at an overall efficiency of 67% with an input power of 3 kw. Data are presented on the compatibility of tungsten, molybdenum, and boron nitride in a hydrogen flow at temperatures in the range 2,000° to 3,000° K. The thrustor supersonic nozzle design was based on an analytical study that included the effects of boundary-layer growth. An area ratio of 30 at a conical expansion total angle of 30° was chosen. Author

N64-31088* Hughes Research Labs., Malibu, Calif.
RESEARCH ON PROBLEMS OF ION BEAM FORMATION FROM ELECTRON BOMBARDMENT ION SOURCES Summary Report
H. J. King 18 Aug. 1964 39 p refs
(Contract NAS3-4118)
(NASA-CR-54143; HRL-4118-S) OTS $2.00 fs; $0.50 mf

Cathode life in Kaufman-type mercury electron-bombardment ion thrustors has been limited by sputtering erosion caused by ions from the plasma accelerated through the cathode sheath. This contract has been concerned with the development of a cathode in which this problem is eliminated by operating the discharge in an arc mode, using the surface of liquid mercury as the cathode, and utilizing the removal of liquid mercury atoms from the cathode by the discharge as the propellant feed mechanism. This also eliminates the need for a liquid–vapor phase separator in the feed system. To provide a stable equilibrium position independent of gravitational forces for the mercury surface, the mercury is forced through a porous tungsten plug or small orifice and held as a thin film or drop by surface tension forces and arc pressure. Cathodes of this design yield a ratio of electrons to atoms leaving the cathode of > 25, and they have been successfully operated in ion thrustors of the above type. Author

N64-31199 Rocketdyne, Canoga Park, Calif.
PERFORMANCE DATA FOR INDIVIDUAL ATLAS MA-2 AND MA-5 ENGINES
10 Sep. 1963 54 p
(Contract AF 04(695)-306)
(R-5108-1; AD-421471)

Specific performance data for individual MA-2 and MA-5 booster, sustainer, and Vernier engines are presented. The values presented are arranged to fulfill the need for accurate information to be used when calculating flight trajectories for missiles powered by the Atlas MA-2 or MA-5 propulsion systems. The engine parameters were determined through use of the most recent data-reduction computer programs and procedures. The applicable data-reduction computer program for each engine is shown, and the applicable procedures for each type of engine are outlined. P.V.E.

N64-31209* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ELECTROSTATIC THRUSTOR FOR SPACE PROPULSION, PRESENT AND FUTURE
William R. Mickelsen and Harold R. Kaufman Repr. from J. Brit. Interplanet. Soc. (London), v. 19, 1963–1964 p 319–337 refs Presented at the Symp. on Advanced Propulsion Systems, London, 9 Oct. 1963 Previously announced as NASA-TM-X-51710; see N64-24030 16-27
(NASA-RP-318; NASA-TM-X-51710)

The detailed status of electrostatic thrustor components is examined on the basis of performance in space missions. The electron-bombardment thrustor appears to be superior to other thrustors at present. With the thrustor mission-performance analysis as a background, research programs are described for electron-bombardment thrustors and contact-ionization thrustors. The critical component in the electron-bombardment thrustor is the cathode, and recent data indicate that durable, low-power cathodes can be developed. The performance of the contact-ionization thrustor is severely limited by porous-tungsten technology. Colloidal-particle thrustors are still in the research stage, but appear to have the best promise for high efficiency at low specific impulse, low mass, and programed specific impulse operation. Author

N64-31264 Picatinny Arsenal, Dover, N.J.
SHOCK INITIATION THROUGH A BARRIER
Robert L. Wagner Sep. 1963 38 p
(TR-3085; AD-420869)

The results of a feasibility study of the practicality of initiating a rocket motor through a barrier using high explosives without perforating the barrier are summarized. Results indicated that a variety of explosives and barriers could be made to work in such a system. A system was designed in which the design parameters consisted of PETN, which is initiated by shock through a 0.1-in. steel barrier. This was applied to initiation of a rocket motor with success. Author

N64-31291 Rocketdyne, Canoga Park, Calif.
PERFORMANCE DATA FOR INDIVIDUAL ATLAS MA-2 AND MA-5 ENGINES
29 May 1964 50 p Supersedes R-5108-2; see N64-21116
(Contract AF 04(695)-528)
(R-5108-3; R-5108-2; AD-601721) OTS: $1.75

This report updates and presents specific performance data for indivdual MA-2 and MA-5 booster, sustainer, and vernier engines. These data can be used to optimize vehicle trajectories. Author

N64-31340* National Aeronautics and Space Administration, Washington, D.C.
THE MECHANICS OF LOW-THRUST SPACE FLIGHT, IV [MEKHANIKA KOSMICHESKOGO POLETA S MALOY TYAGOY, IV]
G. L. Grodzovskiy, Yu. N. Ivanov, and V. V. Tokarev Jul. 1964 62 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 4, no. 2, 1964 p 392–423
(NASA-TT-F-9033) OTS: $3.00 fs; $0.50 mf

A description of known analytic solutions of the equations of dynamics, exact and approximate, based on small perturbation forces is presented. Also described are numerical methods for constructing optimal trajectories and optimal directions. P.V.E.

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see:* 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-30251* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AAS-NASA SYMPOSIUM ON THE PHYSICS OF SOLAR FLARES

Wilmot N. Hess, ed. Washington, NASA, 1964 433 p refs Proc. of a Symp. Held at Goddard Space Flight Center, 28–30 Oct. 1963

(NASA-SP-50) GPO: $3.25

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52. STABILITY OF THE SOLAR MAGNETIC FIELD IN THE REGION OF FLARES J. W. Warwick (High Altitude Obs.) p 441–442 (See N64-30300 22-28)

53. SOLAR MAGNETIC FIELDS AND SPACECRAFT OBSERVATIONS L. Davis, Jr. (Calif. Inst. of Tech.) p 443–444

54. PRODUCTION OF GAMMA RAYS AND NEUTRONS IN SOLAR FLARE REGIONS E. L. Chupp (New Hampshire U.) p 445–449 refs (See N64-30301 22-28)

N64-30252* National Aeronautics and Space Administration, Washington, D.C.

SOLAR FLARES: THEIR STRUCTURE, DEVELOPMENT, AND MOTION

Henry J. Smith *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 1–14 (See N64-30251 22-28) GPO: $3.25

Most solar flares begin as one or more points that brighten rather suddenly. Soon larger features emerge as flare components from the plage, that is, the generally concentrated bright chromospheric consituents of the chromospheric structure that surrounds activity centers. The intensities of individual points rise rapidy in the initial phase. During this brightening, the affected areas grow at first along the local fibrille structure, then they seem to swell. At this phase, adjoining parts usually emerge to form intensely bright areas that only partly follow the configuration of the preflare chromospheric structure. Then there are those flares seen at the limb. Their shapes may be mounds with cones or spikes, loop structures, or irregular in structure. Although flares, in general, are not kinematic phenomena, many flares do have an aspect involving dynamic motion. This is the ejection of visible gas in the form of surges or spray prominences. I.v.L.

N64-30253* McMath-Hulbert Observatory, Pontiac, Mich.

MOVING MATERIAL ACCOMPANYING THE FLARE OF 1959 JULY $16^d21^h14^m$ UT

Helen W. Dodson and E. Ruth Hedeman *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 15–23 refs (See N64-30251 22-28) GPO: $3.25

More than 500 spectroheliograms in 25 "series" or λ-sweeps were made throughout the course of the (3+) Hα-flare. Since the flare was relatively close to the center of the solar disc, ascending and decending motions of the hydrogen atoms resulted in doppler shifts and introduced differences in the spectroheliograms made with radiation from the red and violet sides of the center of Hα. Interpretation of these spectroheliograms indicates that the inferred prominence motions during this disc flare are consistent with observations of prominence activity during certain major flares at the limb, that is, ejections in the premaximum and early stages and systems of loop-type prominences and descending material in the postmaximum or late phase. These loops often continue after the Hα flare and associated ionospheric disturbances have ceased. In addition, the filament activations recorded on center-of-Hα filtroheliograms were measured photometrically, and these activations are discussed. I.v.L.

N64-30254* Paris Observatory, Meudon (France)

OPTICAL CHARACTERISTICS OF CHROMOSPHERIC FLARES ASSOCIATED WITH TYPE IV RADIO BURSTS OR NOISE STORMS

Y. Avignon, C. Caroubalos, M. J. Martres-Trope, and M. Pick *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 25–26 refs (See N64-30251 22-28) GPO: $3.25

Sixteen chromospheric flares associated with polar-cap absorption (PAC) were considered. The characteristics common to these flares allowed the following definition of a new class of flare, designated as type-A configuration. The centers of activity are made up of two rows of spots of opposite polarity; the minimum distance between these two rows is generally less than 1 heliographic degree. These flares have two, approximately parallel, bright filaments; each covers a row of spots of the same polarity. This type-A configuration is related

only to those bursts accompanied by proton events. Subsequently, chromospheric flares associated with meter wavelength radio events—metric type IV, or noise storm—were examined. For all cases not associated with a PCA, it was found that the position of the flares lies partly along the position of the filaments that are present in the interior of centers of activity—the plage filaments. It was shown that the total area of the umbra and penumbra covered by the flare is the characteristic quantity that defines the importance of the HF radiation (2800 to 9400 Mc/sec) associated with it. I.v.L.

N64-30255* National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
FLARE IMPORTANCE RATINGS—SOME HOPE FOR IMPROVEMENT
Constance S. Warwick *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 27–28 (See N64-30251 22-28) GPO: $3.25

The National Bureau of Standards is attempting to carry out a flare-importance-ratings program by grouping together reports that pertain to a given flare, and by applying corrections to each reported importance rating to derive final values that are free from systematic errors. For IGY, the number of flares per UT observing hour can be made uniform for flares of importance ≥ 2. The center-limb distribution is uniform for flares of corrected importance I or greater. Although the systematic errors can be removed, at least for the larger flares, the more or less random disagreement among reports of a given flare, as measured by the sum of the square deviations from the mean, is only slightly improved. The corrected values offer an improvement over the original values, mainly because they cannot introduce spurious and misleading relations into solar or geophysical studies utilizing flare data. I.v.L.

N64-30256* High Altitude Observatory, Boulder, Colo.
SPECTOGRAPHIC OBSERVATIONS
Harold Zirin *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 33–48 (See N64-30251 22-28) GPO: $3.25

Spectrographic observations of solar flares are reviewed in the the light of the following: (1) problems of observing flare spectra—the distinction between the portion of the spectrum due to the flare itself and that due to the excited background, etc; (2) the spectrum of flares in the extreme ultraviolet; (3) the analysis of the various radiations in the flare spectrum—analysis of the continuum, analysis of the coronal lines in the flare, and analysis of the X-ray spectrum; (4) the temperatures of the preponderance of the flare material above the limb—coronal temperatures; and (5) interpretations of the hydrogen lines in the solar flare. I.v.L.

N64-30257* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIME VARIATIONS IN THE SOLAR EXTREME ULTRAVIOLET SPECTRUM OBSERVED BY OSO I
Werner M. Neupert *In its* AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 49–61 refs (See N64-30251 22-28) GPO: $3.25

A grazing incident spectrometer was flown as a pointed experiment on OSO I (1962 ζ1) to monitor the extreme ultraviolet (euv) spectrum of the sun. Over 6,000 spectra were obtained at a rate of about 100 per day, from March through May 1962, corresponding to nearly three solar revolutions. Intermittent operations have subsequently provided spectra for a period greater than 1 year. This paper presents, in condensed form, the variations observed in three of the more reliably identified lines of the spectrum: 284A (Fe XV), 304 A (He II), and 335A (Fe XVI). The solar euv observations may be considered as falling into three categories: (1) quiet corona; (2) slowly varying components; and (3) transient phenomena, such as flares. This paper reviews some observations of slowly varying components, and presents several instances in which transient phenomena have been observed. I.v.L.

N64-30258* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR FLARES IN THE LIGHT OF HYDROGEN LYMAN-α
Kenneth L. Hallam *In its* AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 63–64 (See N64-30251 22-28) GPO: $3.25

The total solar flux of hydrogen Lyman α was monitored on OSO I by means of a spectrally selective gas ionization chamber. Useful data were obtained from the date of launch, March 7, 1962, until April 28, 1962. One reading of the flux was obtained every 136 seconds while the satellite was on the sunlit side of the earth. This gave about 20 measurements of the Lyman α flux per orbit. Only those events with sustained enhancements greater than the fluctuating part of the signal could be detected. During this observing period of 53 days, five flares of optical importance 2 or greater—three class-2 flares and three class-3 flares—were associated with detectable enhancements in Lyman α. All Lyman α enhancements occurred mainly within the duration of the Hα flare. There is apparently no typical time dependence of the variation in Lyman α. The time peak of the Lyman α enhancement does not necessarily coincide with the Hα flare maximum, but usually precedes it slightly. I.v.L.

N64-30259* Osservatorio Astrofisico di Arcetri, Florence (Italy)
BROADENING AND ASYMMETRY OF THE EMISSION LINES IN FLARES
Maria C. Ballario *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 65–70 refs (See N64-30259 22-28) GPO: $3.25

The effect of motion inside a loop structure—with two branches diverging from the solar surface and inclined at an angle of 50° to the solar radius—on the emission lines was examined. Macroscopic motion was assumed. If V_1, V_2, and V_3 are the velocities of the three different parts of the loop, the sight-line components V_1^*, V_2^*, and V_3^* are functions of the heliocentric angle v and of the motion direction inside the flare. But in every case there are, in this loop model, two components of opposite signs. It was also assumed that broading and asymmetry may be due to a double mechanism. The Hα line was examined. The calculated values of the effective width of the line and the assymetry for different values of v were in good agreement with the following experimental results: (1) The broadening increases with the increasing values of v. (2) The asymmetry decreases with the increasing values of v. (3) The asymmetry is prevalently red asymmetry. (4) The center of the blended line has small displacements from the normal Hα center. (5) The lines are broadened because they consist of superposed components. I.v.L.

N64-30260* Joint Inst. for Laboratory Astrophysics, Boulder, Colo.
SOLAR FLARES AND THE LOOP PROMINENCE MECHANISM
John T. Jefferies and Frank Q. Orrall (Sacramento Peak Obs.) *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 71–76 refs (See N64-30251 22-28) GPO: $3.25

Loop prominences sometimes form above solar flares during their decline from maximum and may exist for several hours following the flare, but all flares do not produce loop

prominences. It is suggested that all loop prominences are preceded by great flares, thus they may be considered as rare postflare phenomena. The loop-flare mechanism may be explained as follows. Energetic particles that are injected into the bottom of the loop are rapidly thermalized at the top, producing a dense high-temperature region. (The source of these energetic particles is most probably the coronal reservoir of energetic particles that these flares produce.) This region expands rapidly, but is contained by the magnetic field and so accelerates the material along the loop, causing much of the motion evidenced by the wide wings and displacements of the Hα line. This rapid heating also causes the radio bursts and X-ray emission that accompany rapid changes in the loop prominences. It is estimated that the total energy loss of the loop system is $\approx 3 \times 10^{31}$ ergs, and that 5×10^{31} ergs of energy are required to maintain the system. I.v.L.

N64-30261* Sacramento Peak Observatory, Sunspot, N. Mex.
N. Mex.
MASS BALANCE IN FLARE LOOPS
Joseph Kleczek *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 77–80 refs (See N64-30251 22-28) GPO: $3.25

Mass balance in flare loops was investigated for the purpose of explaining the source of the large amount of Hα material that is condensed (the appearance of knots and streamers in Hα over the solar limb) and subsequently streams into the chromosphere. The size, height, and velocity of all of the streamers of several loop systems were measured through the systems' lifetimes, for example, events such as those of May 8, 1956, September 11, 1956, and October 22, 1956. Results of this investigation indicate the following: (1) Coronal condensation cannot supply sufficient material for loop formation; therefore, a powerful mechanism must exist for transporting material from lower, denser atmospheric layers during and after some flares. (2) Loop prominences appear to outline magnetic tubes of force. Observations showed that the condensation process proceeds at the top of the loop. I.v.L.

N64-30262* Netherlands Foundation for Radio Astronomy, Dwingelo
ON THE STARK BROADENING OF HIGH BALMER LINES EMITTED BY SOLAR FLARES
L. D. de Feiter *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 81–85 refs (See N64-30251 22-28) GPO: $3.25

In 1959 Suemoto and Hiei showed that the Balmer line spectra of solar flares could be interpreted only when it was assumed that the emission takes place in small filamentary structures. This conclusion was confirmed by Svestka in 1962. In their analysis these authors treated the Stark broadening according to the classical Holtsmark theory. It is shown in this paper that the conclusions remain valid when the effects of the electrons on the Stark-broadening parameters is taken into account. Author

N64-30263* Mount Wilson Observatory, Pasadena, Calif.
MAGNETIC OBSERVATIONS RELATING TO SOLAR FLARES
Robert Howard (Palomar Obs.) *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 89–94 refs (See N64-30251 22-28) GPO: $3.25

The existence, the importance, and to some extent, the development of solar flares are dependent on the configuration of local magnetic fields. Flares are more likely to occur in magnetically complex active regions than in magnetically simple active regions. Their dependence on the complexity of the magnetic configuration is much greater for the more important flares. In general, flares tend to occur during the stages and growth of the sunspot group, although there is evidence that the flares with the greatest geophysical effects occur in decaying spot groups. Many flares originate near what may be neutral points in the magnetic field. Generally, the occurrence of a flare results in the decrease of the magnetic gradients in the vicinity of the neutral point, either because of a decrease of the fields or because of a separation of the nearby spots. However, during and for an hour or two after the flare, the nearby spots approach the flare. It is impossible, with the present observations, to pinpoint the exact time of the changes in the magnetic field. I.v.L.

N64-30264* Crimean Astrophysical Observatory (USSR)
ON THE BEHAVIOR OF MAGNETIC FIELDS ASSOCIATED WITH SOLAR FLARES
A. B. Severny *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 95–101 refs (See N64-30251 22-28) GPO: $3.25

All available maps of the longitudinal magnetic field were examined in cases where magnetographic records before and after a flare were available. In seven cases out of eight, the gradients of the field, which were 0.1 + 0.05 g/km before the flare, were reduced to the lower values ($\approx$ 0.02 + 0.01 g/km) after the event. The simplification of the field was found to be the most characteristic phenomenon accompanying flares. Recent progress in recording transverse magnetic fields permitted a comparison of the observed pattern of magnetic-field changes associated with solar flares with that produced by a corresponding magnetic configuration of dipoles—sunspots. Fifty-two configurations of magnetic fields of sunspot groups before and after flares of importance $\geq$2 and, especially, those associated with cosmic-ray flares were examined. It was found that all large cosmic-ray flares are associated with a quite pronounced change in the configuration of sunspots; namely, in most of the cases one of two or three separate polarities of the same "sense" is pushed out, while the polarities of opposite "sense" are slightly attracted after the flare, or the whole configuration is expanded. I.v.L.

N64-30265* North American Aviation, Inc., Downey, Calif.
ASSOCIATION OF FLARES WITH STATIONARY POINTS OF ZERO MAGNETIC FIELD
James Weddell *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 103–106 refs (See N64-30251 22-28) GPO: $3.25

The positions at which solar flares originate have been correlated with measurements of the photospheric magnetic field made on the day of each flare and, at times, as much as 35 days before each flare. The 51 flares considered occurred in 1959 and 1960, had corrected areas at least 100$\mu_\odot$ (millionths of the solar hemisphere), and were associated with calcium plage regions that were making their first disk passages. Author

N64-30266* Sacramento Peak Observatory, Sunspot, N. Mex.
ON THE OBSERVABLE EFFECTS OF MAGNETIC ENERGY STORAGE AND RELEASE CONNECTED WITH SOLAR FLARES
Hermann U. Schmidt *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 107–114 refs (See N64-30251 22-28) GPO: $3.25
(Contract AF 19(604)-6664)

A classification of the possible magnetic changes in the solar atmosphere in terms of their observable effects is proposed. Ten magnetograms taken before and after the great flare of July 16, 1959, are used to compute the changes of the total flux and of the total magnetic energy in a current-free approximation. Large and rapid changes are found. Two independent characteristic lengths of the field in this region are also

derived. These do not exhibit comparable changes, but only a moderate expansion. This would suggest the existence of major changes in the total flux without corresponding changes in the geometrical distribution of this flux. Author

N64-30267* Minnesota U., Minneapolis School of Physics
ENERGETIC X-RAY BURSTS FROM SOLAR FLARES
John R. Winckler *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 117–129 refs (See N64-30251 22-28) GPO: $3.25

The X-ray bursts from solar flares constitute the most energetic electromagnetic radiation that has been received from the sun. This report summarizes recent cases of energetic X-ray events studied with high-altitude balloons and rockets, and their relation to the high-energy processes in solar flares. Emphasis is placed on possible origins of the energetic photons of the flares. I.v.L.

N64-30268* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR X-RAYS: A COMPARISON WITH MICROWAVE RADIATION
W. A. White *In its* AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 131–137 refs (See N64-30251 22-28) GPO: $3.25

Analysis of data from the OSO I satellite shows that solar X-rays of less than 10 A exhibit a violent dynamic behavior that contains within it counterparts of the somewhat less dramatic behavior of the solar microwave flux. Specifically, the solar X-ray flux contains the following: (1) a slowly varying component; (2) "gradual rise and fall" bursts; and (3) impulsive bursts. The OSO I data show the first two to be related to their microwave counterparts, and the empirical relations are given in this paper. Observations at 10 A of the third component (impulsive bursts) could not be associated directly with microwave observations because of the extreme disparity in sensitivities of the two methods of observing this phenomenon. Author

N64-30269* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMMENTS ON HIGH ENERGY X-RAY BURSTS OBSERVED BY OSO I
Kenneth J. Frost *In its* AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 139–143 refs (See N64-30251 22-28) GPO: $3.25

Instrumentation aboard the first Orbiting Solar Observatory observed five separate instances of high energy X-ray bursts accompanying solar flares. The X-ray bursts were observed in the 20- to 100-kev range. Data on the types of flares producing the X-ray bursts and the associated microwave radio bursts are presented. Author

N64-30270* Naval Research Lab., Washington, D.C. E. O. Hulbert Center for Space Research
SOLAR X-RAY EMISSION—NRL RESULTS
Herbert Friedman *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 147–157 refs Sponsored by ONR and NSF (See N64-30251 22-28) GPO: $3.25

This report concerns recent results that have added to the detailed knowledge of the solar spectrum and of the distribution of X-ray sources in the solar atmosphere. Included are measurements of the line spectrum from 1 to 25 A, fan beam scans to resolve the dimensions of active regions, and spectroheliograms in the UV lines of highly ionized coronal ions. With respect to flare spectra, previously unpublished data in the 2- to 20-Kev region are presented and interpreted in terms of possible thermal mechanisms. I.v.L.

N64-30271* Commonwealth Scientific and Industrial Research Organization, Sidney (Australia) Radiophysics Lab.
RADIO OBSERVATIONS OF SOLAR FLARES
J. P. Wild *In* NASA Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 161–177 ref (See N64-30251 22-28) GPO: $3.25

Solar flares have been observed on the earth throughout the range of radio wavelengths capable of penetrating the earth's atmosphere—that is, from $\lambda \approx 4$ mm to $\lambda \approx 60$ m. The bursts of solar radiation recorded in this vast range seem to fall phenomenologically into three distinct, though perhaps overlapping, wavelength ranges. These ranges are referred to as the microwaves ($\lesssim$20 cm), the decimeter waves (10 cm–1 mm), and the meter waves ($\gtrsim$1 m). Broadly, the physical distinction between phenomena in the different ranges can be traced to the region of the radiation—micro-waves mainly in the chromosphere, meter waves in the corona, and decimeter waves presumably in the region of transition through often confused by overlapping coronal and chromospheric effects. Author

N64-30272* Tata Inst. of Fundamental Research, Bombay (India)
THE SLOWLY VARYING COMPONENT OF SOLAR RADIO EMISSION
G. Swarup *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 179–198 refs (See N64-30251 22-28) GPO: $3.25

Measurements of solar radio emission at centimeter and decimeter wavelengths revealed a component that varies slowly from day to day, and showed a good correlation with the total visible sunspot area. It has been called the slowly varying component, or S-component, and is superimposed on a steady background level that is attributed to thermal emission from the quiet sun. This report summarizes the observations of the slowly varying component for a strong radio source (area of the associated sunspot group > about 500 millionths of visible hemisphere) and a weak source (sunspot area < 200 millionths), with emphasis on their wavelength dependence. Various theories of the origin of the radio emission are discussed, and some results concerning the observed association between the strength of the S-component and the flare activity of a solar active region are discussed. It was established that the S-component originates at heights of about 10^4 to 10^5 km above the photosphere, in regions of high coronal densities and magnetic fields that lie above sunspots and plages. It appears that the radio emission is due to two different thermal mechanisms—electron–ion collision absorption, and resonance absorption at harmonics of gyromagnetic frequency. I.v.L.

N64-30273* Paris Observatory, Meudon (France)
STUDY OF SOLAR NOISE STORMS AT 169 MC/S WITH THE AID OF THE NANCAY INTERFEROMETER
A. M. Le Squeren *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 199–202 refs (See N64-30251 22-28) GPO: $3.25

The measurement of the positions of noise storm centers with the Nancay interferometer, which is carried out with a precision of the order of the minute of arc, has permitted a more effective study of the connection between these storms and the centers of optical activity. The following points are emphasized: (1) the relation between storm commencements and the chromospheric flares; (2) the connection between the sense of polarization of storms and the hemisphere in which the visible

center associated with the coronal center is located; and (3) the variation of the apparent position of the storms as a function of heliocentric longitude. Author

N64-30274* Paris Observatory, Meudon (France)
STUDY OF THE SLOWLY VARYING COMPONENT AT 9400 MC/S AS A FUNCTION OF SOLAR ACTIVITY
C. Caroubalos *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 203–205 refs (See N64-30251 22-28) GPO: $3.25

The centers of solar activity, called radioelectrical condensations, are associated with continuous emission observed mainly at the centimeter wavelengths. These centers are sometimes the seat of chromospheric flares that give rise to various radioelectrical emissions. Among the latter, type-IV radio bursts are particularly significant. This report discusses those centers, associated with a detected centimetric condensation, that produce type-IV bursts during their passage across the solar disk. The dependence of the flux density on the corresponding optical importance is plotted. This optical importance is related approximately linearily to the spot area. It was found that for an identical optical importance, only centers associated with the most intense condensations give rise to type-IV bursts. The efficiency of these centers, designated repetition centers, does not appear to be constant in the course of a solar-activity cycle. The repetition character of these centers increases sensibly as the solar cycle decreases. I.v.L.

N64-30275* Tokyo Astronomical Observatory (Japan)
ACTIVE DARK FILAMENTS AND TYPE III BURSTS
Tatsuo Takakura and A. Tlamicha *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 207–208 refs (See N64-30251 22-28) GPO: $3.25

At the Ondrejov Observatory, simultaneous observations of a spectroheliosoope by L. Krivsky and of radiometers at 231 and 260 mc/s by A. Tlamicha were made that showed a clear time coincidence between a type of group bursts—even when the duration is short—and active dark filaments without a flare, in more than 15 cases during 1960 to 1962. This type is a group of short-duration bursts without remarkable enhancement of base level. To identify the spectral type of these bursts, the same type of groups recorded at the Tokyo Astronomical Observatory with a polarimeter at 200 mc/s, was compared with the spectral data (15 to 210 mc/s) obtained at Dapto Station, Sydney. The above type of bursts seems to be of the group-III bursts. Also, these bursts were almost unpolarized as is usual with the type-III bursts at 200 mc/s. I.v.L.

N64-30276* Lockheed Aircraft Co., Burbank, Calif. Lockheed Solar Observatory
THE ASSOCIATION OF BREMSSTRAHLUNG X RAYS WITH EXPLOSIVE FLARES
Gail E. Moreton *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 209–212 refs (See N64-30251 22-28) GPO: $3.25

The optical properties of the solar flares associated with nine bremsstrahlung events are considered. The Hα filtergrams of these events were inspected. All nine events shared a special optical characteristic—the flares were of the explosive type. It is indicated that the explosive effect in some flares is caused by a sudden nonthermal energy process in a localized region of an otherwise normal flare. The normal flare produces low-velocity ejecta and a variety of slow emissions, such as the long-enduring centimetric burst and low-energy X-rays. Smerd suggests that these "glow-like" emissions are electromagnetic only, and that they probably arise from thermal or quasi-thermal processes, such as compression of chromospheric regions by excess magnetic pressure. The explosive phase, on the other hand, is the relevant time for the acceleration of a burst of electrons to relativistic energies and for the production of centimetric emission and hard X-rays by synchrotron and bremsstrahlung processes. I.v.L.

N64-30277* Minnesota U., Minneapolis School of Physics
A REVIEW OF SOLAR COSMIC RAY EVENTS
William R.Webber *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 215–255 refs (See N64-30251 22-28) GPO: $3.25

Solar cosmic-ray events considered in this review are defined as those events having occurred when a detectable intensity increase (above the nominal galactic cosmic-ray background of 4 particles/cm^2/sec) of cosmic rays with energy >10 MeV is observed near the earth. Data on cosmic-ray events are presented within the framework of a simple diffusion picture for the propagation and decay of the particles, and it is indicated that many of the features of the onset and almost all of the decay features are inconsistent with this picture. One of the main objectives of this study was to lay the groundwork for an evaluation of the intensity and spectrum of the solar cosmic rays at injection. The time of injection and the period during which the injection occurs were determined in a number of events. The determination of the intensity and spectrum of the particles at injection depends critically on the features of the model for the propagation of the solar particles to the earth. Within the framework of a suitably modified diffusion model, the determination of the injection spectrum was attempted by two methods—consideration of the onset of the indirect particles, and consideration of the onset of direct particles (or those that propagate directly along the field lines without appreciable scattering). I.v.L.

N64-30278* Michigan U., Ann Arbor Radio Astronomy Observatory
THE ASSOCIATION OF ENERGETIC PARTICLES WITH SOLAR FLARES
John M. Malville *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 257–261 refs (See N64-30251 22-28) GPO: $3.25
(Contract NAS5-2051)

The association of energetic particles with solar flares is reviewed. It is indicated that three separate phases of a flare, associated with the generation of energetic particles, may be distinguished. These are the phases: (1) the brief acceleration of keV electrons during the flash phase, as evidenced by type-III bursts, X-ray bursts, and impulsive centimeter-wave bursts; (2) the acceleration of keV and MeV and of MeV and BeV protons during the postmaximum phase indicated by umbral obscuration and centimeter type-IV radiation; and (3) the storage of energetic particles in the corona resulting perhaps in the heating of a magnetically connected condensation, the generation of meter wave and decimeter wave continuum emission, and the eventual drift of particles onto lines of force connected with the earth's neighborhood. I.v.L.

N64-30279* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CHARGE COMPOSITION OF ENERGETIC SOLAR PARTICLES
Carl E. Fichtel *In its* AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 263–271 refs (See N64-30251 22-28) GPO: $3.25

Experimental observations on the composition of solar cosmic rays are reviewed, and an effort is made to show how

these data, when combined with other pertinent information, aid in the examination of two problems—the dynamics of particle propagation in interplanetary space, and the solar composition. Differential spectra for protons, helium nuclei, and medium nuclei as a function of the total energy per nucleon in units of nucleon rest energy; differential spectra for protons, helium nuclei, and medium nuclei as a function of rigidity, the relative abundances of nuclei in solar cosmic rays, the sun, and galactic cosmic rays with a base of 10 for oxygen; solar electron–proton ratios; the differential rigidity spectra of hydrogen, helium, and medium nuclei; and the proton–helium nuclei ratios as a function of the kinetic energy–nucleon at several different times are presented in graphic and tabular forms. The data indicate that it appears possible to say that a purely rigidity-dependent propagation can be excluded. Therefore, other general classes of propagation must be examined. As to the relation between solar cosmic-ray composition and that of the sun, there are a number of experimental facts that suggest that the relative abundances of the multiply charged nuclei (at least in the range $2 \leq Z \leq 20$) may reflect those of the sun. I.v.L.

N64-30280* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

MARINER SOLAR WIND MEASUREMENT

Conway W. Snyder *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 273–278 (See N64-30251 22-28) GPO: $3.25

The Mariner II data coincide with solar rotations 1767 through 1771. Data are shown that depict the measured plasma velocity averaged over 1 day. There are 19 major peaks in the velocity–time graph. These peaks show a tendency to occur in groups with approximately 27-day spacing. The most conspicuous and persistent of these groups appears from 7 to 10 days after the beginning of a solar rotation. These velocity peaks are interpreted as streams of high-velocity plasma that are continuously ejected from particular regions on the sun. There were 17 flares, all of which were within 8° of the latitude of Mariner; every one of these occurred in a plage region that was associated with one of the velocity peaks on the basis of time coincidence. Thus it may be that, although the observed plasma streams do not come from the flares but from plage regions, there is something about the flare-associated plages that causes them to produce especially high-velocity plasma streams. Of the 19 principal velocity peaks, at least 15 can be plausibly associated with particular long-lived calcium plages, and all such plages lie between the equator and 12° N. The other four peaks may represent plasma coming from a flare. The most interesting and most puzzling thing about the Mariner data is the apparently anomalously short transit times. I.v.L.

N64-30281* Smithsonian Astrophysical Observatory, Cambridge, Mass.

SOLAR SURFACE NUCLEAR REACTIONS

Edward L. Fireman *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 279–284 refs (See N64-30251 22-28) GPO: $3.25

The high tritium and helium-3 content in Discoverer 17 material indicates that nuclear reactions occurred on the solar surface during the November 12, 1960, flare. The ratio of helium-3 to tritium was approximately 70. If the tritium and the helium-3 are interpreted as the stripping of helium-4 flare particles in the solar atmosphere, the path length is at least 10 gm/cm^2. This lower limit on the path length is approximately the same as the upper limit, which is determined from the ratio of boron to carbon nuclei in the flare. The path length appears to be too restricted for the helium-3 and tritium to be produced solely by the stripping of helium-4 particles. It is more likely that the helium-3 and tritium are produced in a thermonuclear reaction. Author

N64-30282* Academy of Sciences (USSR), Moscow Astronomical Council

SOME PROPERTIES OF CORPUSCULAR STREAMS FROM THE CHROMOSPHERIC FLARES

E. R. Mustel and N. B. Egorova *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 285–286 refs (See N64-30251 22-28) GPO: $3.25

Chromospheric flare data used in the present investigations were obtained from two lists of flares of importance greater than 2. A distribution of chromospheric flares on the solar disk showed that the longitudinal distribution of the number of geomagnetically active chromospheric flares is practically uniform. Since this distribution does not give any idea about the intensity of those geomagnetic disturbances created by the flares at different longitudes—an intensity that must give very important information about the spatial distribution of gases ejected from the flares—this intensity effect was investigated. It was found that the ejection of gases from a sufficiently intense chromospheric flare (of importance 2 or 3) is practically uniform. Because the gases that produce sporadic geomagnetic disturbances are generally the most dense component of the gases ejected by a chromospheric flare, one cannot speak about the rise in the planetary space surrounding the sun of such regular radial formations as magnetic bottles, etc. On the contrary, there are reasons to believe that high-energy particles producing, for example, ground-level effects in cosmic-ray increases, move from the flare along those relatively stationary magnetic tubes—coronal rays—that proceed from each active region in the form of strongly bent spirals. I.v.L.

N64-30283* Academy of Sciences (USSR), Moscow Astronomical Council

ON THE POSSIBLE ROLE OF FLARE-LIKE NONSTATIONARY PROCESSES IN THE ORIGIN OF SOLAR WIND

E. R. Mustel *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 287–288 (See N64-30251 22-28) GPO: $3.25

Reported is the discussion following the presentation of the paper on the analysis of geomagnetic disturbances recorded at the polar caps of the earth. In the paper it is felt that the continuous outflow of gases from the undisturbed regions of the sun, the solar wind, is produced at least partly by some nonstationary processes in the solar envelope and that these processes have some resemblance to chromospheric flares. Author

N64-30284* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

VELOCITY DEPENDENCE AND SOURCE SPECTRA OF SOLAR PROTON EVENTS

D. A. Bryant, T. L. Cline, U. D. Desai, and F. B. Mc Donald *In its* AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 289–297 refs (See N64-30251 22-28) GPO: $3.25

Solar particle events consisting of radiation with energy above 1 MeV can be classified into four distinct categories. The distinction between these categories depends on the manner in which the particles are transported from the sun to the region of the earth. The first two classes consist of particles that arrive at the earth in a manner determined by particle velocity—the first category consists of predominantly higher energy particles that arrive after a nearly direct transit, and

the second category consists of those that arrive after a diffusive propagation. The third category consists of particles that arrive in a manner determined by the motion of enhanced solar plasma, and the fourth consists of particles that depend on the rotation of the sun. Typical time delays for these categories are described. Several velocity-order events observed in Explorers XII and XIV were examined, and the velocity dependence of category two was used to determine the energy spectrum of the particles at the time of release from the sun. I.v.L.

N64-30285* Sacramento Peak Observatory, Sunspot, N. Mex.
CASE HISTORIES OF FLARES: THE LARGE FLARES OF JULY 11, 12, 18, AND 20, 1961
Anton Bruzek *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 301–322 refs (See N64-30251 22-28) GPO: $3.25

Flare phenomena from a series of large flares were combined and related to form a picture of a "complete" large-flare event. The visible phenomena discussed were based on Hα photographs. The configurations and dynamics of the preflash phase and the explosive or flash phase are described as are the time elements involved. It appears that all of the energy of the flare is released by the primary flare mechanism during the flash (explosive) phase in a huge blast (10^{32} to 10^{33} ergs in 1000 sec or less). After the maximum of the electromagnetic radiations of the flare (which themselves are secondaries of the original energy output) there are only effects and processes of decline, diffusion, and redistribution of energy. The optical flare expands and fades, sometimes showing slow, divergent motions (velocity of a few km/sec). A somewhat puzzling, and not yet understood, phenomenon that is visible in the later stages of great flares is the loop prominence system (flare loops). I.v.L.

N64-30286* Fraunhofer Inst., Freiburg (W. Germany)
AN ASSEMBLY OF FLARE OBSERVATIONS AS RELATED TO THEORY
K. O. Kiepenheuer *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 323–331 refs (See N64-30251 22-28) GPO: $3.25

A short description of the observed macroscopic configurations of flares, spot groups, and dark filaments is given. The possible subtelescopic structure of flares is discussed. It is shown that the high-energy output of a flare (particle energies and radiation) must be produced in situ. The energy probably cannot be transferred to the flare's volume from the outside. To supply the energy, the assumption of the annihilation of a field of a few hundred gauss within the flare obviously cannot be avoided. The close relation between flares and filaments, as well as the activation of the associated filaments (increase of density and of internal turbulence) well before the optical onset of the flare, suggests that this activation is already part of the flare phenomenon. Author

N64-30287* Cornell U., Ithaca, N.Y.
A SURVEY OF THE INTERPRETATIONS OF RADIO AND X-RAY BURSTS
Mukul R. Kundu *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 335–342 refs (See N64-30251 22-28) GPO: $3.25

This report is concerned principally with the following mechanisms of generation, with regard to the radio and X-ray emissions from solar flares: (1) Bremsstrahlung from Ionized Solar Plasmas—Thermal bremsstrahlung is responsible for the quiet sun and the slowly varying component of radio and X-ray emission and, possibly, for some cm-λ and X-ray bursts. Nonthermal bremsstrahlung is responsible for certain cm-λ bursts and high-energy X-ray bursts during solar flares. (2) Gyro and Synchrotron Radiation from Electrons in the Presence of a Magnetic Field—The gyroradiation (low-order harmonics of the gyrofrequency) from electrons in the sun-spot magnetic field is responsible for a part of the slowly varying component on short cm wavelengths and possibly for noise storm radiation on m wavelengths. The synchrotron radiation appears responsible for type-IV continuum bursts. (3) Radiation from Plasma Waves Excited in the Solar Atmosphere by Corpuscular Streams Ejected from Solar Flares—The corresponding excitation of a longitudinal plasma wave by a single or incoherently acting electron seems to be the plasma-wave analog of Cerenkov radiation. Such plasma radiation can account for type-II and type-III bursts on m waves. I.v.L.

N64-30288* Commonwealth Scientific and Industrial Research Organization, Sidney (Australia) Radiophysics Lab.
ON THE GENERATION OF SOLAR RADIO BURSTS
S. F. Smerd *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 343–355 refs (See N64-30251 22-28) GPO: $3.25

The following properties of waves, plasmas, and their interactions are discussed: (1) the wave modes at which radio waves can be excited and propagate in the solar plasma; (2) some general requirements on source electrons and generating mechanisms to account for the observed high brightness temperatures; and (3) some characteristics of the radiations emitted by three known emitting mechanisms. Author

N64-30289* Stanford U., Calif. Inst. for Plasma Research
TYPE III SOLAR RADIO BURSTS
Peter A. Sturrock *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 357–364 refs (See N64-30251 22-28) GPO: $3.25
(Grant AF-AFOSR-62-326)

A theoretical interpretation of type III solar radio bursts is presented. The observed frequency range of the emission is from 600 mc down to about 5 mc for the fundamental, the time duration being about 10 sec. It appears that type III bursts are related to the flash phase of chromospheric flares, although the event giving rise to a type III burst is frequently too weak to be observed optically. The proposed chain of physical mechanisms giving rise to this radiation is as follows. The solar flare produces a stream of high-energy electrons that travels out through the corona, necessarily following any magnetic field that may be in existence, and excites plasma oscillations in the ambient coronal plasma. These oscillations are coupled in some way to electromagnetic waves so that radiation appears at the plasma frequency and also at twice the plasma frequency. Comparison of the frequency drift rates with interferometric measurements indicates that the exciting source (electron beam) has a velocity in the range of 0.2 c to 0.8 c, and that the beam is traveling along a coronal streamer in which the density is about 10 times that of the normal coronal density. I.v.L.

N64-30290* Tubingen U. (W. Germany)
SOME NOTES ON THE RELATIONS OF X-RAY, PARTICLE, AND RADIO EMISSION OF THE SUN DURING FLARES
Gerhard Elwert *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 365–370 (See N64-30251 22-28) GPO: $3.25

Some relations that seem to exist in the X-ray radiation, the particle emission, and certain types of radio emission are discussed. Measurements of X-ray emissions made by Friedman during a flare of class +2—a flare of medium intensity—were examined. About 2 1/2 and 5 minutes after the maximum

intensity in Hα, the X-ray emission was measured in the wavelength ranges between 0.2 A and 0.6 A, 2 A, and 8 A, as well as between 8 A and 20 A. The spectrum of the 0.2 A and 0.6 A range may be interpreted as bremsstrahlung of electrons of a hot gas with a Maxwellian velocity distribution. The absolute value of the flux was 8×10^{-5} erg/cm^2/s. In the range between 2 A and 8 A, a total flux of 0.2 erg/cm^2/s was measured, and between 8 A and 20 A, a minimum of 0.5 erg/cm^2/s was measured. A spectrum was derived that represented not only the measured flux between 2 A and 20 A but also the radio emission at 3 A and 8 A, these belonging to a range that differs from that of X-rays by about eight orders of magnitude. Therefore, not only the X-ray emissions but also the radio emission of the cm range can be interpreted as thermal ones. I.v.L.

N64-30291* Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.

RADIOFREQUENCY RADIATION AND PARTICLE ACCELERATION FROM SOLAR FLARE FILAMENTS DUE TO COLLECTIVE MOTION AT MULTIPLES OF THE CYCLOTRON FREQUENCY

Richard L. Moore and J. R. Johnston *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 371–376 refs (See N64-30251 22-28) GPO: $3.25

A mechanism is proposed through which the turbulent energy of a plasma is converted into induction and traveling RF fields. The mechanism is the rotational collective motion of an ion or electron gas in a magnetic field at both the plasma frequency and multiples of the cyclotron frequency. A cylindrical ring of the gas involved is assumed to have its macroscopic angular velocity equal to the cyclotron frequency. Coupling between the convective terms of the acceleration field and the electromagnetic potentials results in waves rotating around the axis whose intensity is given by the turbulence intensity. These current waves emit RF radiation which, as it travels outward, also travels around the axis at angular rates that are integral fractions of the plasma frequency, or of the cyclotron frequency. Author

N64-30292* Yale U., New Haven, Conn.

ELECTROMAGNETIC RADIATION FROM PLASMA OSCILLATIONS

Ludwig Oster and M. Altschuler *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 377–381 refs (See N64-30251 22-28) GPO: $3.25 (Grant NsG-176-61)

The general nature of a mechanism that would be able to produce electromagnetic radiation of the kind observed in type-III bursts is determined. This mechanism is shown to be a generalized bremsstrahlung mechanism whose spectral features are computed numerically in the single-particle limit. Refinements that permit relating the remaining observational details to the particulars of the exciting stream are described. Author

N64-30293* Tokyo Astronomical Observatory (Japan)

TYPE II BURSTS AND THE MAGNETIC FIELD IN THE CORONA

Tatsuo Takakura *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 383–385 refs (See N64-30251 22-28) GPO: $3.25

Smerd, et al., have suggested that a type–II burst is a continuous succession of fast-drift bursts. The slow disturbance of the order of 10^3 km/sec seems to be a seat of continuous ejections of high-energy electrons that excite plasma waves. Larentz reported that runaway electrons from a shock front may excite coherent plasma waves. This report derives values showing the velocity range of runaway electrons that excite coherent plasma waves. (Radio waves are caused by the scattering of the plasma waves due to thermal fluctuations.) Also derived is the condition necessary for radio waves, caused by Rayleigh scattering of the plasma waves, to be unpolarized. In addition, various modes of band splitting of type-II bursts are discussed. It is indicated that if the radio waves emitted by the Rayleigh scattering of the plasma waves at ω_1, the minimum frequency, are unpolarized, then another band at ω_2, a higher frequency, is also unpolarized even if the band splitting is due to the magnetic field. I.v.L.

N64-30294* Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research

MAGNETIC ENERGY SHEDDING IN THE SOLAR ATMOSPHERE

Thomas Gold *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 389–395 (See N64-30251 22-28) GPO: $3.25

The manner in which the dissipation of magnetic energy can occur in the solar atmosphere, both in the steady conditions of plages and in the sudden event of flares, is discussed. The particular geometric configuration of the Hoyle–Gold theory of flares was used. Two examples of magnetic dissipation are described: (1) The magnetic field is represented under the condition of a turbulent conducting medium existing below a plane and an insulating medium above. The fluid pressure is assumed large compared with magnetic forces. (2) The magnetic field in a turbulent medium is represented. The fluid pressure is assumed to be large compared with magnetic forces below the dividing plane and to be small compared with the magnetic forces above it. Three processes that can dissipate energy are discussed—one involves adiabatic motion, another involves nonadiabatic motion, and the third involves the setting up of unstable configurations. Each process occurs in the upper space as the motion below causes the feet (the normal component across the dividing plane) to move. I.v.L.

N64-30295* Michigan U., Ann Arbor Radio Astronomy Observatory

THE ORIGIN OF SOLAR FLARES AND THE ACCELERATION OF CHARGED PARTICLES

Donat G. Wentzel *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 397–407 refs (See N64-30251 22-28) GPO: $3.25

Theories concerning flares have been guided by two major considerations. First, the energy related by a large flare has led to postulating a supply of magnetic energy. It must then be explained how the required magnetic fields are created, how they are stored in the chromosphere, and how the magnetic energy may be suddenly released at the time of a flare. This release may be in the form of a breakdown when the stored energy exceeds some critical value. Alternately, the release may follow the creation of a magnetically neutral point or surface where the field strength vanishes. The cause of the flare is then assigned, essentially, to a pinch effect. Various methods have been suggested for the acceleration of the charged particles associated with solar flares. These are discussed under the following headings: electric fields, betatron acceleration, and Fermi acceleration. The flaw in these methods or theories is that each explains only one type of particle. I.v.L.

N64-30296* Glasgow U. (Gt. Brit) University Observatory

INSTABILITY PROBLEMS IN THE ORIGIN OF SOLAR FLARES

Peter A. Sweet *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 409–414 refs (See N64-30251 22-28) GPO: $3.25

The types of hydromagnetic instability that could account for the sudden onset of flares are discussed. Emphasis is laid on the possibility of a large-scale resistive instability. An outline is given of a method by which the existence of such a mode could be established theoretically. Author

N64-30297* Imperial Coll. of Science and Tech., London (Gt. Brit.)
REMARKS ON THE DISCHARGE THEORY OF FLARES
James W. Dungey *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 415–416 refs (See N64-30251 22-28) GPO: $3.25

Three areas relating to flare observations are discussed. These are as follows: (1) flare growth rate; (2) acceleration of particles; and (3) the topology of field points and its association with proton events. I.v.L.

N64-30298* Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies
COMMENTS ON UNDERSTANDING THE SOLAR FLARE
Eugene N. Parker *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 417–418 refs (See N64-30251 22-28) GPO: $3.25

The solar-flare phenomenon is a transient effect on the sun, which the best observational estimates show to be principally an outburst of solar corpuscular radiation or solar wind. To a lesser extent, the flare is an outburst of energetic particles and electromagnetic radiation. The visible portion of the flare above the photosphere has typical maximum dimensions of a few times 10^4 km in all three directions. Thus, the visible flare is a phenomenon that occurs in the lower corona. It is believed that the outburst of solar corpuscular radiation comes from the solar corona too, as the result of the enhanced temperatures observed with the flare. Thus the flare seems to be a coronal phenomenon, the visible portion of which is always associated with sunspots. In addition, two tractable types of flare prediction are discussed. I.v.L.

N64-30299* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MECHANISM FOR THE DISSIPATION OF THE MAGNETIC FIELD IN SOLAR FLARES
Radhe K. Jaggi *In its* AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 419–423 refs (See N64-30251 22-28) GPO: $3.25

The physical mechanism for the dissipation of a magnetic field, considered in this report, occurs in three stages. First, the two dipole magnetic fields situated in the solar atmosphere approach each other and "squash" together, changing the nearly curl-free magnetic field into a magnetic field with a curl. It is assumed that this stage takes a time equal to that given by the flare dimensions ($\approx 3.10^8$ cm) divided by a typical fluid velocity for the chromospheric plasma (3.10^5 cm/sec^{-1}), that is, of the order of 1000 sec. The second stage consists of the occurrence of finite conductivity instabilities. The appropriate times for the growth of instabilities is of the order of 10^{-3} sec and is achieved for values of $a \lesssim 10^2$cm, where a is the thickness of the current sheath. The third stage consists of the dissipation of the disordered magnetic field in the central region. The dissipation time of the magnetic field is a few milliseconds in the case where $T = 10^4$ deg K, and the scale of the magnetic field is 10^2 cm. I.v.L.

N64-30300 High Altitude Observatory, Boulder, Colo.
STABILITY OF THE SOLAR MAGNETIC FIELD IN THE REGION OF FLARES
James W. Warwick *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 441–442 (See N64-30251 22-28) GPO: $3.25

The stability of the solar magnetic field in the region of flares is reviewed. The complex postflare loops were shown in the same flaring region. They appeared in absorption against the disc of the sun and were remarkably similar in position and distribution to the filamentary bright structures of the preceding flare. It would seem that, in this event, the loops define, at their highest point, the locus along which lies the bright emission of the flare itself. Each loop has an apparently poloidal shape, if it can be inferred that it is the same as postflare loops seen in other events at the limb. This structural relation, which appears in many flares, is evidence for the stable configuration of the magnetic field shapes from flare to postflare conditions. The conclusion can be drawn that there is negative evidence for changes in field strength or configuration during a major flare. Furthermore, it appears that a self-consistent role for the eruptive prominences observed during and after flares lies in the readjustment of coronal magnetic fields to fit changes in photospheric current distributions. This readjustment cannot occur impulsively in the coronal plasma, but in a way dictated by the propagation conditions of hydromagnetic shocks or waves. I.v.L.

N64-30301 New Hampshire U., Durham
PRODUCTION OF GAMMA RAYS AND NEUTRONS IN SOLAR FLARE REGIONS
E. L. Chupp *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 445–449 refs (See N64-30251 22-28) GPO: $3.25

Estimations are made of production of neutrons and gamma rays by nuclear reactions at the sun. It is assumed that all nuclear species are present after acceleration in proportion to their normal solar-surface abundances. The type of acceleration mechanism generally considered to be operative under the dynamic conditions existing in solar-flare regions is the Fermi mechanism. To a first approximation then, all charged particles will have the same final velocity, independent of their mass and charge. Thus it is expected that all particles would achieve the same final energy per nucleon. The total 100-Mev neutron production was estimated to be 5×10^{29} T_b neutrons, where T_b is the bombardment time of the dense medium. The average flux of Mev neutrons at the earth is 1.8×10^{-4} T_b where T_b is on the order of 1000 sec. Taking an average cross section of 1 barn for 100-Mev protons and an abundance ratio of 3×10^{-3} for gamma-producing nuclei to neutron-producing nuclei gives a flare gamma-ray production of 2×10^{28} γ/sec. At the earth, this corresponds to ≈ 5 photons/cm^2/s. This estimate is for large flares (total energy of 10^{32} ergs). I.v.L.

N64-30302* Atomic Energy of Canada Ltd., Chalk River, Ontario Deep River Lab.
A PROCESS FOR FLARES
Hugh Carmichael *In* NASA, Goddard Space Flight Center AAS-NASA Symp. on the Phys. of Solar Flares 1964 p 451–456 refs (See N64-30251 22-28) GPO: $3.25

A concept of the solar-flare process is presented. An important feature of this concept is that the primary energy involved in flares is the mechanical energy of the solar wind—the magnetic field acts only as a temporary store for this energy. Another feature of the concept is that the energy of the magnetic field, when a collapse occurs, is first utilized in the direct acceleration of particles to higher energies. Further, it is considered that the same primary source of mechanical energy, the solar wind, is itself the agent that propels disturbances from the sun to the earth. Thus it follows that the energy

associated with a flare is principally the energy initially transferred from the magnetic field to the accelerated particles. On its way to the earth the front of this disturbance, because of the postulated rapid expansion of its balloon-like structure, probably moves faster than the ambient solar wind and so may be expected to generate the relatively weak, and often quite thin, shock needed for the sudden commencement. A rapid expansion of the disturbance is necessary to provide the very wide angle of emission from the active center characteristics of these disturbances. I.v.L.

N64-30458 High Altitude Observatory, Boulder, Colo.
INTEGRATED INDICES OF THE SOLAR CORONA, 1963
Dorothy E. Trotter and Kathryn La Velle 15 May 1964 9 p Prepared in cooperation with the Sacramento Peak Obs. Sponsored by NBS and AF
(HAO-60)

Presented are the daily mean integrated coronal indices for the following: (1) the λ5303 emission line (Fe XIV) for the visible solar disk, and for the whole sun; and (2) the λ6374 emission line (Fe X) for the visible disk, and for the whole sun. Author

N64-30484 California U., Berkeley Cosmic Ray Group
[RESEARCH IN HIGH ENERGY PARTICLE PHYSICS AND RESEARCH ON COSMIC RAYS AND SOLAR PARTICLE EMISSIONS] Final Report, Dec. 15, 1954–Jun. 30, 1963
W. B. Fretter, R. R. Brown, and K. A. Anderson 26 Jun. 1964 8 p refs
(Contract Nonr-222(40))
(AD-601938)

Methods used for analyzing high-energy cosmic-ray jets in nuclear emulsion overestimated the energies of such jets by factors of 2 to 10. Analysis was then undertaken of high-energy nuclear interactions observed in a heavy-liquid bubble-chamber operation. The 3-pion invariant mass obtained clearly shows two peaks—one at about 1100 MeV and another at 1300 MeV. Routine observations of neutron cosmic-ray intensity were made for a period of several years and correlated with cosmic-ray increases occurring during solar flares. A.W.

N64-30505* State U. of Iowa, Iowa City
MEASUREMENTS OF ENERGETIC ELECTRONS IN THE VICINITY OF THE SUNWARD MAGNETOSPHERIC BOUNDARY WITH EXPLORER XIV
L. A. Frank and J. A. Van Allen Aug. 1964 37 p refs
(Grant NsG-233-62; Contract Nonr-1509(06))
(NASA-CR-58787; SUI-64-20) OTS: $2.00 fs; $0.50 mf

This report summarizes observation made with Explorer XIV of the intensities of electrons $E_e > 40$ Kev near the magnetospheric boundary and within the transition region, on the generally sunward side of the earth during the period May–August 1963, and considers the significance of the results obtained. I.v.L.

N64-30518* Franklin Inst., Swarthmore, Pa. Bartol Research Foundation
DATA REDUCTION AND ANALYSIS FOR HEAVY PRIMARY COSMIC RAY EXPERIMENT IN EXPLORER VII SATELLITE Final Report, 1 Nov. 1961–31 Dec. 1963
M. A. Pomerantz 24 Jun. 1964 75 p refs
(Contract NASr-79)
(NASA-CR-58203) OTS: $3.00 fs; $0.75 mf

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3. SOLAR-PRODUCED HEAVY NUCLEI DURING NOVEMBER, 1960 M. A. Pomerantz and L. Witten (Martin Co., Baltimore) 7 p refs (See N64-10167 01-28)
4. SATELLITE-BORNE INSTRUMENTATION FOR OBSERVING FLUX OF HEAVY PRIMARY COSMIC RADIATION P. Schwed, M. A. Pomerantz (Franklin Inst.), H. Hanson, and H. Benjamin 17 p refs (See N64-30519 22-15)

N64-30572 Los Alamos Scientific Lab., N. Mex.
SOLAR FLARE X RAY EMISSION MEASUREMENTS AND PLASMA OBSERVATIONS AT $10^{5}_{JN}^{KM}$
J. P. Conner, W. D. Evans, M. D. Montgomery, S. Singer, and E. E. Stogsdill [1963] 32 p refs Sponsored by AEC

Solar X-ray-emission and charged-particle-flux measurements made by instruments on the Vela satellites, launched in October 1963, are discussed. Measurements are reported that indicate the existence of electrons with energy > 60 keV, inside a cone of approximately 20° to 30° half-angle about the sun–earth line on the night side of the earth and at geocentric distances of 17 to 19 earth radii. Measurements of solar X-ray emission for the interval of October 18 to November 1, 1963, are described. It is found that there is a general correlation between observed X-ray flux and reported solar flares. Also, comparison of individual events, for which there are both measured X-ray signals and flare reports, shows that a wide range of X-ray fluxes may be associated with flares of a single class. P.V.E.

N64-30575 Joint Publications Research Service, Washington, D.C.
INFRARED RADIATION COEFFICIENTS AND DIFFERENCES IN THE PARAMETER $\gamma = (k\ \rho\ c)^{-1/2}$ FOR THE SEAS AND CONTINENTS ON THE MOON'S SURFACE
M. N. Markov and V. L. Khokhlova 23 Sep. 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. CLVII, no. 2, 1 Aug. 1964 p 826–829
(JPRS-26521; TT-64-41779) OTS: $1.00

Color temperature was determined, using the ratio of the values of the radiation flux in two spectral intervals. The windows of atmospheric transparency 8μ to 13μ, and 3.6μ were chosen. Integral equations are given for the fluxes from the lunar surface in both of the above spectral regions, and methods for determining the coefficients of reflection and emission are discussed. The observed difference in fluxes apparently should be attributed to the differences of the value $\gamma = (k\ \rho\ c)^{-1/2}$ for the seas and continents. (Here k is the heat conductivity, ρ is the density, and c is the heat capacity.) According to computations, when the observed value is $\gamma = 600$, the observed difference in the fluxes corresponds to a difference in γ of about 20%. I.v.L.

N64-30822 RAND Corp., Santa Monica, Calif.
MAGNETOSPHERE AND RADIATION BELTS
J. W. Kern Sep. 1964 115 p refs Submitted for Publication
(P-2917)

Observations and theories on the interactions among the geomagnetic field, charged particles, and neutral ionized gases are reviewed. Copious references are given. The motions of individual charged particles in a nonuniform magnetic field are outlined in a discussion of the behavior of energetic particles moving in the geomagnetic field. These dynamic processes are important in the interpretation of geomagnetic effects of trapped radiation and in relation to detailed theories of geomagnetic storm phenomena. Although it is now possible to formulate models of the earth's immediate environment that closely approximate the observed phenomena, a number of unsolved problems remain, including the following: (1) the intermediate transformations of solar energy that provide the energy source for geomagnetic disturbances and energetic particle fluxes; (2) local acceleration mechanisms of trapped radiation; (3) the role of energetic trapped plasmas in geomagnetic disturbances; and (4) the characterization and morphology of geomagnetic disturbance, particularly in its dynamic aspects. M.P.G.

N64-30834* Consultants and Designers, Inc., Arlington, Va.
ON THE SPECTRA OF CORONAL IONS CONNECTED WITH sp^3-CONFIGURATIONS [O SPEKTRAKH KORONAL'NYKH IONOV SVYAZANNYKH s KONFIGURATSIAMI sp^3]
A. A. Nikitin 4 Aug. 1964 6 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 41, no. 3, 1964 p 482-4
(Contract NAS5-3760)
(NASA-TT-F-8940; ST-SP-10186) OTS: $1.00 fs; $0.50 mf

The energy of ^5S metastable states and that of some other levels of $2s2p^3$ and $3s3p^3$ configurations are estimated by semiempirical methods. The wavelengths and the probabilities of forbidden transitions $s^2p^2\ ^3P$ to $sp^3\ ^5S$ are estimated in ultraviolet spectra of coronal ions belonging to the $2s^22p^2$ and $3s^23p^2$ isoelectronic sequences. Author

N64-30842* Consultants and Designers, Inc., Arlington, Va.
OBSERVATION OF JUPITER'S RADIO EMISSION IN THE 6.5 CM WAVE IN PULKOVO [NABLYUDENIYE RADIOIZLUCHENIYA YUPITERA NA VOLNE 6.5 CM V PULKOVE]
V. Ya. Gol'nev, N. M. Lipovka, and Yu. N. Pariyskiy 27 Aug. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (Moscow), v. 157, no. 3, 1964 p 554–556
(Contract NAS5-3760)
(NASA-TT-F-8949; ST-RA-10196) OTS: $1.00 fs; $0.50 mf

The following results were obtained from observations of Jupiter's radio emission at the 6.5-cm wavelength: (1) The flux from Jupiter is equal to $8.15 \pm 0.8 \times 10^{-26} w/m^2mc$ at a distance of 4 au, which corresponds to a disk brightness temperature of 324° ±30° K. (2) Comparison of the observations with computed values of radiation-pattern widening for various models of radioemitting regions of Jupiter indicate an absolute blackbody temperature of 128° K. (3) The residual emission polarization after accounting for blackbody emission was found to be less than 18%. (4) No correlation between Jupiter's radio emission flux and solar activity was indicated. M.P.G.

N64-30848* Consultants and Designers, Inc., Arlington, Va.
THE ATMOSPHERIC SCATTERING INDICATRIX IN THE VISUAL AND ULTRAVIOLET REGIONS OF THE SPECTRUM [ATMOSFERNAYA INDIKATRISA RASSEYANIYA V VIZUAL'NOY I UL'TRAFIOLETOVOY OBLASTYAKH SPEKTRA]
V. E. Pavlov 7 Sep. 1964 7 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 3, 1964 p 546–549
(Contract NAS5-3760)
(NASA-TT-F-8955; ST-OA-10202) OTS: $1.00 fs; $0.50 mf

The results of measurements of sky brightness in the visual and ultraviolet regions of the spectrum are presented. It is shown that multiple scattering of light cannot be wholly responsible for the decrease in the elongation of the observed scattering indicatrix and its diffraction pattern with wavelength decrease. Author

N64-30849* Consultants and Designers, Inc., Arlington, Va.
PECULIARITIES OF X-RAY EMISSION OF PROTON FLARES [OSOBENNOSTI RENTGENOVSKOGO IZLUCHENIYA PROTONNYKH VSPYSHEK]
A. S. Dvoryashin 10 Sep. 1964 18 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 4, Jul.–Aug. 1964 p 626–634
(Contract NAS5-3760)
(NASA-TT-F-8956; ST-SP-10204) OTS: $1.00 fs; $0.50 mf

The temporal regularities of ionosphere effects related to proton flares are investigated. It is established that hardening of the X-ray emission spectrum of a series of proton flares takes place. It is assumed that this radiation occurs at deceleration of high-energy electrons in the dense atmosphere layers (nonequilibrium radiation). The generation of very hard X-ray photons and their relationship with an intense radioburst in centimeter waves indicates that the latter is probably due to synchronous emission of electrons, accelerated in the magnetic fields of the active region. It is established, for a series of intense proton flares, that an X-ray emission by the active region takes place after the flare's glow in $H\alpha$ has practically subsided. A conclusion is derived about a balanced character of this emission, whose source lies in the plasma localized in coronal condensations. Author

N64-30850* Consultants and Designers, Inc., Arlington, Va.
A STRANGE LUMINOUS PHENOMENON [UN PHENOMENE LUMINEUX ETRANGE]
W. Groubé 10 Sep. 1964 3 p Transl. into ENGLISH from L' Astronomie (Paris), May 1964 p 168
(Contract NAS5-3760)
(NASA-TT-F-8957; ST-OA-10205) OTS: $1.00 fs; $0.50 mf

On 9 February 1964, around 1835 hours, a large, luminous, elliptical spot, hazy in outline, was seen in the southeastern sky at Fez, Morocco. Its color was red in the highest part and blue–greenish in the remainder; the line of separation between the colors was rather clear. The very soft light held its maximum intensity for 5 minutes, after which it began to decrease rapidly, becoming a small, dark, red spot that definitely disappeared after another 5 minutes. The phenomenon lasted about 20 minutes in all. The dimensions of the spot were estimated at 7° for the horizontal diameter and 5° for the vertical diameter. The small star of 4-Z magnitude, Leporis, was visible across the blue–greenish zone. The phenomenon would seem to be due to the decomposition of solar light by a cloud of unknown nature, giving an image of the star as reflected by another cloud with the reflecting surface inclined about 35°. R.L.K.

N64-30857* Consultants and Designers, Inc., Arlington, Va.
THE EFFECTIVE LUNAR SURFACE TEMPERATURE DUE TO THE REFLECTION FROM IT OF COSMIC RADIO EMISSION [EFFEKTIVNAYA TEMPERATURA LUNNOY POVERKHNOSTI, OBUSLOVLENNAYA OTRAZHENIYEM OT EYE KOSMICHESKOGO RADIOIZLUCHENIYA]

A. M. Starodubtsev 29 Sep. 1964 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 3, 1964 p 399–405
(Contract NAS5-3760)
(NASA-TT-F-8964; ST-LPS-10212) OTS: $1.00 fs; $0.50 mf

The effective temperature due to the reflection from the moon's surface of cosmic radio emission at 100, 200, and 400 mc/sec is computed for the lunar surface. A dielectric sphere with a perfectly smooth surface, with permittivity equal to 1.5 to 4, has been considered as the model of the moon. It follows from calculations that the average brightness temperature varies little as a function of the moon's elevation angle, some increasing taking place only in the region $\alpha = 280°$; and the radiation polarization ratio depends little on the frequency, not exceeding 12% for $\epsilon = 1.5$, its average value being ~ 2% to 5%. Author

N64-30858* Consultants and Designers, Inc., Arlington, Va.
PHYSICAL CONDITIONS IN THE VICINITY OF THE SOLAR SYSTEM ACCORDING TO POLARIZATION MEASUREMENT DATA OF COSMIC RADIO EMISSION [FIZICHESKIYE USLOVIYA V OKRESTNOSTYAKH SOLNECHNOY SISTEMY PO DANNYM IZMERENIY POLYARIZATSII KOSMICHESKOGO RADIOIZLUCHENIYA]
V. A. Razin 30 Sep. 1964 8 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 3, 1964 p 395–398
(Contract NAS5-3760)
(NASA-TT-F-8965; ST-RWP-10214) OTS: $1.00 fs; $0.50 mf

Observations of the Faraday rotation of the polarization plane of cosmic radio emission constitute a very promising method of investigation of interplanetary and interstellar media. The rotation angle of the emission's polarization plane, during radiowave propagation in space, is given by the formula

$$\psi = \frac{0.94 \cdot 10^6}{\omega^2} \int_0^L NH_{\parallel}\, dl, \qquad (1)$$

where $\omega = 2\pi\nu$ is the cyclical emission frequency in cps, N is the number of electrons per cm^3, $H_{\parallel}$ is the longitudinal component of the magnetic field in oersteds, L is the wave path in cm. By measuring the angle ψ, one quantity

$$\int_0^L NH_{\parallel}\, dl$$

can be determined, which constitutes an important integral characteristic of the medium through which the radiowaves propagate. Author

N64-30957* Rochester U., N.Y.
ISOTOPIC COMPOSITION OF LOW ENERGY HYDROGEN NUCLEI IN THE PRIMARY COSMIC RADIATION
G. D. Badhwar 8 Jul. 1964 17 p refs Partially Sponsored by NASA Submitted for Publication
(Grant AF-AFOSR-439-63)
(URPA-45; AD-604098)

The abundance of low-energy deuterons and tritons has been determined in a nuclear emulsion stack exposed at Fort Churchill, Manitoba, Canada (geomagnetic latitude $\lambda = 73°$ N), under 4.2 g/cm^2 of residual atmosphere. Using the grain density vs residual range method for the identification of tracks produced by particles, the differential flux of deuterons and tritons has been determined. The results appear to be consistent with the absence of deuterons and tritons in the primary cosmic radiation. An upper limit on the amount of hydrogen traversed by low-energy cosmic-ray particles has been placed. Author

N64-30973 State U. of Iowa, Iowa City
ON THE RELATIONSHIP BETWEEN ABSOLUTE SOLAR COSMIC RAY INTENSITY AND RIOMETER ABSORPTION
J. A. Van Allen, W. C. Lin, and H. Leinbach Jul. 1964 40 p refs
(Contract Nonr-93803)
(SUI-64-29; AD-604197)

A study has been made of eight separate solar cosmic-ray events during 1960 using the following (1) observations above the atmosphere by satellite Explorer VII of the integral omnidirectional intensity of particles J_0 ($E > E_0$), where E_0 is 30 MeV for protons and 120 MeV for alpha particles; and (2) corresponding riometer values of atmospheric absorption A of cosmic radio noise at 27.6 Mc/sec from College and Thule stations. The quantities $A/J_0^{1/2}$ and J_0/A^2 are calculated as a function of kinetic energy E for monoenergetic beams of pure protons and pure alpha particles. Using these results, it is shown that certain specified ranges of the experimental parameter $H(E_0) = J_0(E > E_0)/A^2$ for actual solar cosmic-ray beams lead uniquely to the conclusion that atmospheric absorption is due primarily to particles of energy less than, approximately equal to, or greater than E_0. Observed values of H are quite different for different events during 1960, covering the range 40 to less than 10^{-2} $(db^2\ cm^2\ sec)^{-1}$. Author

N64-31082* National Aeronautics and Space Administration, Washington, D.C.
THE VELOCITY OF CORPUSCULAR STREAMS IN THE SOLAR CORONA BASED ON OBSERVATIONS OF SOLAR RADIO EMISSION [O SKOROSTI POTOKOV CHASTITS V SOLNECHNOY KORONE PO NABLYUDENIYAM RADIOIZLUCHENIYA SOLNTSA]
I. G. Moiseyev Oct. 1964 23 p Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 24, 1960 23 p refs
(NASA-TT-F-227) OTS: $0.75

The velocity of the perturbing agent in the solar corona has been estimated from radio bursts of type II, with allowance for coronal condensations. The resulting velocities agree well with the mean velocities of corpuscular streams responsible for the production of magnetic storms of sudden commencement; they indicate that the corpuscular streams are probably ejected from active parts of the solar surface with high initial velocities and are not accelerated in the corona. Author

N64-31090* Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research
THE INTERACTION OF THE SOLAR WIND WITH COMETS
W. I. Axford Repr. from Planet. Space Sci., v. 12, 1964 p 719–720 refs
(Grant NsG-382)

Discussed is the possible presence of a shock wave in the medium upstream from the nuclei of comets when a type I tail is well developed, and some of its possible effects. The bulk of the electrons in the interplanetary medium, with electron energies of the order of 30 to 80 ev, must be considered as an important factor in the stimulation of live emission, performing a similar function to secondary electrons in the aurora; in particular, these electrons may produce the green (5577 A) and red (6300 to 6360 A) "auroral" lines of OI in comets that appear with a strength inconsistent with excitation by solar electromagnetic radiation. Fast electrons produced as a result of the shock transition are likely to be an important cause of ionization in comets, especially near the nucleus of the comet where the neutral gas density is greatest. IAA

N64-31117 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE COMBINED EFFECTS OF SPACE ENVIRONMENTAL PARAMETERS UPON SATELLITE SYSTEMS AND COMPONENTS: AN ANNOTATED BIBLIOGRAPHY
Charles G. Gros, comp. Jan. 1964 285 p refs
(Contract AF 04(647)-67)
(Rept.-3-35-64-3; SB-64-4; AD-445142)

This bibliography cites material on space environmental parameters in their combined effects upon satellites, satellite systems, and components. Included among these parameters are ablation, acceleration, acoustics, atmospheric and ground conditions, cryogenics, electromagnetism, gravity(including weightlessness), heat, instrumentation, meteoroids and other interstellar matter, radiation, shock, vacuum, and vibration. Measurement and testing, both with respect to methodology and results, are also included. Since the effects of these environmental parameters on manned vehicles is considered together with their effects on the materials comprising satellites, information on human engineering, human factors, and materials is included as well. Author

N64-31215* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE SOLAR SPECTRUM FROM 50 Å TO 400 Å
W. M. Neupert, W. E. Behring, and J. C. Lindsay Repr. from Space Res., IV. Proc. of the 4th Intern. Space Sci. Symp. (Warsaw), 4–10 Jun. 1963 p 719–729 refs
(NASA-RP-338)

Presented are the results of observations of solar extreme UV radiation from 50 to 400 A, made with a scanning monochromator mounted as a pointed experiment on OSO-1. The period of observation was sufficient to observe a slowly varying component having a period of approximately 27 days and correlating with solar activity. The enhancement of radiation during periods of activity was observed to vary from line to line in the spectrum, depending on the origin of the line in the solar atmosphere. The data show an increase in the He II Lyman-alpha (304 A) flux, integrated over the entire solar disk of 33%, during a period when the Zürich Provisional Relative Sunspot Number increased from zero to a maximum of 94. Enhancements of approximately a factor of 4 were observed for the 284 A (Fe XV) and the 335 A (Fe XVI) lines. IAA

N64-31339* National Aeronautics and Space Administration, Washington, D.C.
SOLAR WINDS AND SOLAR CORPUSCULAR STREAMS [SOLNECHNYY VETER I SOLNECHNYYE KORPUSKULYARNYYE POTOKI]
S. K. Vsekhsvyatskiy Aug. 1964 9 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 2, 1964 p 328–333
(NASA-TT-F-9059) OTS: $1.00 fs; $0.50 mf

The correlation between the structure of the outer corona and the variations of the field is noted for a series of eclipses, as is the correspondence between the geomagnetic curve and the situation in the chromosphere of the sun. These data indicate a linear character of the system of solar corpuscular streams and their considerable stability. The correlation between the twenty-seventh day sequences of diurnal K_p indices was studied; the existence of high values of correlation coefficients was established, chiefly for epochs of low solar activity and for periods of maximum values of the earth's heliographic latitude. The stability of the system of corpuscular streams revolving together with the sun follows from these results. Variations of the geomagnetic field reflect the structure of the outer corona in the ecliptic plane in the earth's orbit. Author

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-30337* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EXPLORATION OF THE MOON AND PLANETS
W. H. Pickering *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 85–95 (See N64-30326 22-01) GPO: $1.50

The elementary physics problems of sending instruments, or man, to a nearby planet are briefly reviewed. The engineering problems of interplanetary travel for an unmanned aircraft are illustrated by the Mariner II flight to Venus. R.L.K.

N64-30338* National Aeronautics and Space Administration, Washington, D.C.
EXPLORING THE SOLAR SYSTEM
John E. Naugle *In its* Proc. of The 4th Natl. Conf. on The Peaceful Uses of Space 1964 p 97–108 (See N64-30326 22-01) GPO: $1.50

NASA solar-activity research and its influence on interplanetary space and on the environment of the earth is described. The use of spacecraft in the fields of solar physics, interplanetary space measurements, magnetosphere and ionospheric study, and astronomy are described. R.L.K.

N64-30339* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
DISCOVERIES FROM SPACE EXPLORATION
Robert Jastrow *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 109–121 (See N64-30326 22-01) GPO: $1.50

Some contributions of space science in astrophysics, geodesy, geology, meteorology, and astronomy are reviewed in considerable detail. R.L.K.

N64-30610* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE SECOND-ORDER SOLUTION OF ARTIFICIAL SATELLITE THEORY WITHOUT AIR DRAG
Theodore L. Felsentreger Washington, NASA, Sep. 1964 26 p refs
(NASA-TN-D-1752) OTS: $0.75

A variation of Hansen's method applied to the problem of the near-earth satellite without drag is used to obtain analytic expressions for the second-order short-period and secular perturbations in the Delaunay variable G and for the longitude of the ascending node. Thus an independent check of the second-order determining functions S_2 and ΔS_2 given by Kozai is provided. Substitutions that simplify Kozai's expressions are suggested. Author

N64-30730 Cornell U., Ithaca, N.Y.
STRUCTURE OF THE LUNAR SURFACE
Thomas Gold *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 239–271 refs (See N64-30712 22-16)

There are three distinct types of observable properties of lunar-surface structure—the optical scattering law with angle and polarization of the lunar surface; the thermal radiation, both in the infrared and radio-wave band, and its changes

over the day and during eclipses; and the reflection of radio waves as observed with radar techniques. It is concluded that the majority of the moon's surface has a low-density and high-porosity structure, as well as a deposit of fine rock dust. A.W.

N64-30732 School of Aerospace Medicine, Brooks AFB, Tex.
THE SOLVED AND THE UNSOLVED PROBLEMS
Hubertus Strughold *In its* Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 298–310 (See N64-30712 22-16)

Consideration is given to the medicobiological problems in astronautics, and to physical questions in the exploration of space. Special attention is given to the behavior of the cardiovascular system, and three phases in its response to weightlessness are differentiated. Two tables of bioastronautical data are set up for the lunar and Martian environmental profiles. A.W.

N64-30811 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AGE AND EVOLUTION OF METEORITIC AND TERRESTRIAL MATTER IN LIGHT OF RECENT INVESTIGATIONS
V. I. Baranov and K. G. Knorre 31 Jul. 1964 31 p refs Transl. into ENGLISH from Meteoritika (Moscow), no. 21, 1961 p 15–31
(FTD-MT-64-282; AD-603397) OTS: $2.00

All known facts do not contradict the concept that terrestrial and meteoritic substances were formed in an identical, and possibly, a single process of nucleogenesis. During the formation of the earth and of the large meteoritic and asteroid bodies in first stage, there was isolation or independent formation of shells or bodies with segregated components: Fe, U, Pb. It is possible to consider reliable the finding that the maximum presently known age of terrestrial minerals is not less than 3.5 billion years. This is the lower limit of age of the earth. The upper limit of the age of the earth and meteorites (age of the matter of planetary system) is not more than 5 to 6 billion years. Author

N64-30891 Raytheon Co., Bedford, Mass. Space and Information Systems Div.
OPTIMAL RE-ENTRY GUIDANCE STUDY. PART I: PROGRAM FORMULATION Final Report
Walter Denham 31 Jul. 1964 26 p
(Contract AF 04(695)-348)
(BR-3060-1; AD-603240) OTS: $2.00

A computer program is described that is used to assess the relative performance of different measuring devices employed in a system subject to random errors. The system is composed of the simulation of a vehicle entering the atmosphere of the Earth, a measuring scheme to gather data about the state variables, a data processor (here the Kalman–Bucy filter is used) from which the best estimate of the state variable is obtained from the measurement data, and a control scheme using the processed data in order to calculate the proper control force so that the given mission will be accomplished. A statistical evaluation of the performance of the system is obtained by using as a measure of the performance the terminal quadratic dispersion matrix, which is the terminal mean square deviation of the state variables away from a nominal value. The terminal dispersion matrix is calculated by two different methods in the program: (1) A Monte Carlo analysis is performed by repeatedly running the simulation influenced by random disturbances. (2) By the application of linear theory a matrix differential equation is programed that calculates the propagation of the mean quadradic dispersion matrix. Author

N64-30945 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry and Cartography
A REVIEW ON CLOSE SATELLITE THEORY Report No. 33
Ivan I. Mueller Jun. 1964 87 p refs *Its* Sci. Rept. No. 2
(Contract AF 19(628)-1628)
(AFCRL-64-566(III); AD-605656)

An investigation of the motion of an artificial earth satellite normally proceeds in two steps. (1) Using a simplified case, it is assumed that the mass distribution of the earth and of the satellite are spherical or, what is identical in mechanics, that the masses are concentrated in points. It is also assumed that the motion takes place in a vacuum and that there are no disturbing effects present, due to other celestial bodies or to some physical phenomena. The resulting orbit is called a normal orbit. (2) The factors that deviate from the assumptions and their effect on the normal organ are reviewed. The disturbed normal orbit is called "perturbed." Author

N64-30947 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry and Cartography
SATELLITE PERTURBATIONS DUE TO ZONAL GRAVITATIONAL HARMONICS Report No. 35
Richard H. Rapp Jun. 1964 53 p refs *Its* Sci. Rept. No. 4
(Contract AF 19 (628)-1628)
(AFCRL-566(V); AD-605658)

Literal expressions for the first-order perturbative effects on the parameters of a satellite orbit due to zonal gravitational harmonics to the tenth degree have been derived from the general equations of Kaula. Numerical values from these expressions have been converted to their effect on the apparent night ascensions, apparent declinations, and distances of the satellite. Author

N64-31055 Aerospace Corp., El Segundo, Calif. Electronics Div.
THE GROSS CHARACTERISTICS OF A MULTIPLE FLY-BY MISSION
B. H. Billik 30 Jun. 1964 81 p refs
(Contract AF 04(695)-269)
(TDR-269(4130-13)-1; SSD-TDR-64-137; AD-447693)

This report considers problems associated with selecting and establishing orbits for an interceptor vehicle that will provide multiple flyby capability of a target satellite. The interceptor parking orbit is assumed to be circular, whereas the target orbit may be either circular or elliptic, but of relatively low eccentricity ($0 \leq e \leq 0.16$). The vehicles are assumed to be arbitrarily located in inclined orbits of arbitrary inclination. Primary emphasis is placed on the problems of phasing and velocity expenditure. For the case of circular target orbits, secondary orbit maneuvers designed to correct for the effects of the earth's oblateness on the orbits are generated. Author

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-30708 Aerospace Corp., El Segundo, Calif. Electronics Div.
ATTITUDE ERROR ANALYSIS OF THE SPIN-STABILIZED VELOCITY PACKAGE OF THE ATHENA VEHICLE

Richard M. Allman and Louis K. Herman 10 Jun. 1964 40 p refs
(Contract AF 04(695)-269)
(BSD-TDR-64-69; TDR-269(4810-31)-2; AD-446673)

This report describes an attitude error analysis of the spin-stabilized velocity package of the Athena vehicle, including an analog simulation. The primary purpose of the error analysis was to determine the angle-of-attack of Athena payloads during the early phase of atmospheric reentry. The report includes a description of the analog simulation, a description of the Athena reentry vehicle problem, and noteworthy results of the Athena error analysis. Author

N64-30724 Air Force Flight Test Center, Edwards AFB, Calif.
THE CREWMAN'S VIEWS ON RESCUE IN SPACE
Robert S. Buchanan *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 168–181 refs (See N64-30712 22-16)

The reentry rescue vehicle appears to be more desirable than does the nonreentry vehicle. The lifting-body type should be considered as the reentry rescue vehicle most valuable, from both the technical and the operational viewpoint. Diagrams and photographs of lifting-body types are given. A.W.

N64-30775 Lockheed-California Co., Burbank Scientific and Technical Information Center
SPACE PROGRAMS 1962–1975
E. E. Whitney Oct. 1964 28 p
(SP-3)

Current and planned future space programs, for the period 1962 to 1975, are summarized. The information is listed by the name of the booster used for the launch, and includes designation, name, dimensions, costs, and launching dates (if known). P.V.E.

N64-31216* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPLOITATION OF INERTIAL COUPLING IN PASSIVE GRAVITY-GRADIENT-STABILIZED SATELLITES
Bruce E. Tinling and Vernon K. Merrick Repr. from J. Spacecraft, v. 1, no. 4, Jul.–Aug., 1964 p 381–387 Presented at the AIAA Guidance and Control Conf., Cambridge, Mass., 12–14 Aug. 1963 Previously announced as AIAA Paper 63-342; see N64-23903 16-32
(NASA-RP-339)

A passive, three-axis stabilization system is described that relies solely on the gravity gradient to provide both the damping and the restoring torques for a vertically oriented satellite. Damping is effected by the energy dissipation of any relative motion that exists between the main satellite body and a suitably connected auxiliary body. It is shown that a single auxiliary body having a single degree of freedom can be positioned to introduce inertial coupling that permits the attitude motions about all three axes to be damped. An analysis is presented that leads to the solution of optimum system parameters for an example configuration of this type. Author

N64-31279 Boeing Co., Seattle, Wash.
APPLICATIONS OF X-20 "STATE OF THE ART DEVELOPMENTS" TO FUTURE SPACE SYSTEMS
F. A. Wiggin 23 Dec. 1963 203 p
(D2-81035; AD-447957)

A preliminary listing of technological studies nearly completed at the termination of the X-20 program is presented. Technological studies in the following areas are included: aerodynamics; materials and processes; G&CDM and human factors; cryogenics; hydraulics and pneumatics; landing gear; structures; nose cap; and test instrumentation. P.V.E.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-30333* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MAN'S TRANSPORTATION TO SPACE
Eberhard Rees *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 45–50 (See N64-30326 22-01) GPO: $1.50

Saturns I, IB, and V are described. Major considerations that guide the Saturn launch-vehicle program are the building-block concept, an extensive test and quality-assurance program on the ground, systems engineering, and the all-up concept. A summary flight schedule for Saturn vehicles is given. R.L.K.

N64-30417 Joint Publications Research Service, Washington, D.C.
THE DESIGN OF MULTISTAGE ROCKETS
V. A. Kosmodem'yanskiy *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 1–9 refs (See N64-30416 22-33) OTS: $4.00

A method proposed for obtaining the preliminary design of a multistage rocket is based on the optimum selection of the stages. In this method, a system of relationships among the structural parameters of a multistage rocket and optimization of certain integral characteristics of the movement (e.g., speed, length of the active portion, etc.) occurs at the successive times of the start of the operation of the corresponding stages. The method is discussed as applied to the following design problems: (1) optimum selection of the stages of a nonhomogeneous multistage rocket with maximum speed at the end of the active portion of the flight; (2) design of a composite rocket with maximum duration of the active portion of the flight; and (3) design of a composite rocket with maximum lift in a uniform gravitational field. P.V.E.

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-30331* National Aeronautics and Space Administration. Manned Spacecraft Center, Langley Station, Va.
MAN'S SPACE VENTURE
Robert R. Gilruth *In* NASA, Washington Proc. of The 4th Natl. Conf. on The Peaceful Uses of Space 1964 p 33–39 (See N64-30326 22-01) GPO: $1.50

The concept of large-size governmental support of technical development in peacetime without the impetus of war or defense has raised questions that concern the size of the Government's investment in such a speculative undertaking, the division of effort between the manned and unmanned phases and between the peaceful and military aspects. Major technological problems concern reentry heating and reentry loads. Briefly reviewed are the history of Project Mercury, and the decision to focus the Apollo program on a manned lunar landing within the decade, as well as to undertake Project Gemini as an intermediate step. R.L.K.

N64-30332* National Aeronautics and Space Administration. Manned Spacecraft Center, Langley Station, Va.
MAN'S EXPLORATION OF SPACE
Joseph F. Shea *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 41–44 (See N64-30326 22-01) GPO: $1.50

The rigor of the manned space flight ground-test program is emphasized. A brief description of the Apollo mission and some examples of the problems to be solved are given. R.L.K.

N64-30335* National Aeronautics and Space Administration, Washington, D.C.
MAN'S FLIGHT IN SPACE
George E. Mueller *In its* Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 61–70 (See N64-30326 22-01) GPO: $1.50

Progress in the Apollo effort is summarized, and benefits to the country from the Apollo Project are reviewed. There appear to be no technological problems of a major nature that would interfere with the accomplishment of the program on schedule. The most challenging technical task is the integration of all the systems and subsystems. Review of the overall pace of the Apollo Project indicates it to be quite conservative. The effect of pace upon cost shows that if the remaining 6 years of work were stretched out over 12 years, the total cost of the presently approved program would increase by about $6 billion. It is not expected that meteoroids or radiation in space will be major problems in scheduling the first manned lunar mission. It appears that adequate site-selection information will be available. R.L.K.

N64-30340* Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
NAVIGATION SATELLITES
Richard B. Kershner *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 127–132 (See N64-30326 22-01) GPO: $1.50

The establishment of a civilian or military artificial-satellite system for navigation on a worldwide basis is discussed in terms of concept and of economic factors. Progress in global-navigation accuracy is shown to be dependent on progress in geodesy. Geodetic determinations, based on high-quality data from satellite tracking, can soon be made of all coefficients through sixth order, but more satellites, in a variety of orbits, must be specifically instrumented to meet the needs of the geodesy program. R.L.K.

N64-30341* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
WEATHER SATELLITES
William G. Stroud *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 133–154 (See N64-30326 22-01) GPO: $1.50

Recent technical accomplishments of the Tiros program are described. Nephanalyses (cloud analyses) are produced from the one million bits of data per Tiros picture and are transmitted by facsimile to users. Quantitative radiometric measurements map the spatial distribution of electromagnetic radiation emitted and reflected from the earth; mapping cloud distribution and height (both day and night), stratospheric temperature distribution, and the water vapor in the tropopause is possible with this instrument. Automatic picture transmission (APT) provides a means of transmitting cloud pictures of daylight areas of the earth directly to a user who has inexpensive ground equipment. The spinning 300-pound Tiros, with only 20 watts of power and carrying only 70 pounds of sensors, will be replaced by the 800-pound earth-oriented Nimbus, with 200 watts of power and a capability of carrying at least 250 pounds of sensors and of staying in a polar orbit. Tiros technology will be converted to an operational system for the U.S. Weather Bureau by a modification that provides global coverage. R.L.K.

N64-30342* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMMUNICATIONS SATELLITE TECHNOLOGY
Albert L. Hedrich *In* NASA, Washington Proc. of the 4th Natl. Conf. on the Peaceful Uses of Space 1964 p 155–170 (See N64-30326 22-01) GPO: $1.50

The advantages and disadvantages of active and passive satellite systems are compared. The versatility of the passive system is demonstrated by Echo II. Commercial advantages indicate the use of active satellites. The technology and the communications subsystems of Relay I and Syncom II are described in detail. A major accomplishment has been the developing of scheduling and operating procedures for the Relay satellite. The Syncom program has demonstrated the feasibility of a spin-stabilized, synchronous-orbit, active-communications satellite. Orbital control was achieved without difficulty. The launch by the Thor–Delta booster and the apogee motor boost resulted in the expected near-synchronous orbit. Velocity corrections and spacecraft orientation were made by the spacecraft control subsystem in a predicted manner. R.L.K.

N64-30513* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MARINER II – AN EXAMPLE OF A STABILIZED INTERPLANETARY SPACE VEHICLE Paper No. 130
Dan Schneiderman [1963] 24 p refs Presented at the XIVth Intern. Astronautical Congr., Paris, 26 Sep.–1 Oct. 1963

A description is given of the general considerations that led to the design concepts incorporated into the Mariner II planetary spacecraft. A summary is presented of the Mariner II's flyby of the planet Venus in August 1962. Engineering results are reported by subsystems as follows: structure, temperature control, central computer and sequences, attitude control, power, propulsion, and radio. A.W.

N64-30669 Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.
DIRECT READOUT EQUATORIAL WEATHER SATELLITE (DREWS) Final Study Report
25 Jun. 1964 248 p refs
(Contract NOw-61-0402-d)
(AED-R-2169; AD-443530)

The Direct Readout, Equatorial, Weather Satellite System (DREWS) consists of six television-type, cloud-cover-observation satellites in random orbital relation in a band around the earth from 30° N to 30° S latitude. Each satellite will weigh only 120 lb in order to make possible multiple launching from a single rocket; each uses a spinning-wheel technique that allows continuous viewing of the earth without a complex

earth-orienting system. This satellite system will be compatible with the type of ground station currently being developed for the Nimbus program. Among the study results reported are techniques for multiple-satellite injection; the feasibility of fully automatic satellite operation; ground coverage calculations; parameters for a television camera operating at a 2,000-nmi altitude; communications subsystem parameters; and initial design for the solar-cell power supply. Effects of space radiation on performance and design considerations were also investigated. M.P.G.

N64-30726* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A TECHNOLOGICAL ASSESSMENT OF MANNED ORBITING LABORATORIES
Clinton E. Brown *In* School of Aerospace Med. Lectures in Aerospace Med., 3–7 Feb. 1964 [1964] p 193–207 refs (See N64-30712 22-16)

The orbiting manned space laboratory is an essential part of the technological buildup for answering the critical questions concerned with long durations in space. The most pressing problems are those of man's adaptation to weightlessness (specifically to the reduced gravity found on the moon), and his protection from radiation hazards. Proposed configurations, with supporting Gemini spacecraft ferries, are pictured and described. A.W.

N64-30757 Iowa State U. of Science and Tech., Ames Ames Lab.
POGO PSAG MANUAL
D. R. Fitzwater, E. H. Hietbrink, M. M. Ledet, D. E. Mc Farland, and C. E. Runge May 1964 85 p
(Contract W-7405-ENG-82)
(IS-893) OTS: $2.00

The problem considered in this paper is the design and structure of the POGO monitor. The programs comprising the monitor and the necessary modifications to the compiler systems tape are discussed. Flow charts accompany the writeups. Author

N64-31078 General Dynamics/Astronautics, San Diego, Calif.
RESEARCH DIRECTED TOWARD THE INVESTIGATION OF SUITABILITY OF THE GLOTRAC TYPE G TRANSPONDER FOR USE IN THE RANGE CALIBRATION SATELLITE Final Report, Part C, Volume I
E. C. Lindkvist 1 Jul. 1964 163 p refs
(Contract AF 19(628)-3274)
(GD/A-63-1195(C), Vol. I; AFCRL-64-240(C), Vol. I; AD-447023)

The report covers the results of a feasibility investigation for integrating the equipment required for the Range Calibration Satellite (RCS) into the SATAR spacecraft. A description of the existing SATAR spacecraft is given. This is followed by a discussion of the necessary modifications to incorporate the RCS into SATAR. The report discusses the power system, the telemetry and command system, the attitude control system, the payload and antennas, and temperature control. The report concludes that an integration of the RCS into SATAR can be accomplished successfully. Author

N64-31091 General Electric Co., Philadelphia, Pa. Reentry Systems Dept.
A SIMPLE ENTRY SYSTEM EXPERIMENT FOR MARTIAN ATMOSPHERIC MEASUREMENTS
F. G. Beuf [1964] 14 p refs

This paper discusses the results of a complementary study aimed at the development of a simple, light, sterilizable entry vehicle experiment, designed to gather the necessary information when launched into the Martian atmosphere from a flyby Bus. A low-ballistic-coefficient, minimum-weight vehicle design was generated. In its basic form the system is designed to telemeter vehicle acceleration, base pressure, and atmospheric constituent measurements during entry into the Martian atmosphere. A particular feature of the design is the use of a spherical entry configuration, the symmetrical aerodynamics of which permit the use of a simple, low-data-rate communications system for transmission of vehicle motion data. The vehicle is designed to survive entry and to decelerate to subsonic velocity before impact in any of the presently proposed Martian atmospheres (surface pressures from 11 to 135 mb). Author

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-30416 Joint Publications Research Service, Washington, D.C.
ENGINEERING JOURNAL, NO. 2, 1964
16 Sep. 1964 139 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), v. IV, no. 2, 1964 p 219–224, 251–253, 263–274, 302–309, 357–364, 368–375, 392–423
(JPRS-26417; TT-64-41675) OTS: $4.00

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N64-30419 Joint Publications Research Service, Washington, D.C.
LINEAR THEORY OF THE STABILITY OF CYLINDRICAL CASINGS

A.S. Vol'mir and I. G. Kil'dibekov *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 15–19 refs (See N64-30416 22-33) OTS: $4.00

Basic formulas used for calculating stability in small casings are usually derived by using formulas that are applicable to different casings of other sizes, i. e., "average" or "large" length. This article shows, through the use of formulas constructed by V. Z. Vlasov (the so-called semitimeless theory), that sufficient variations on the original systems of equations can be made to apply to all size loadings. A.W.

N64-30420 Joint Publications Research Service, Washington, D.C.

BENDING ORTHOTROPIC ELLIPTICAL PLATES FREELY SUPPORTED ALONG THE CONTOUR

I. I. Faerberg *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 20–23 refs (See N64-30416 22-33) OTS: $4.00

The problem of bending elliptical orthotropic plates supported along the entire contour is examined. It is shown that in certain cases the problem has an exact solution in elementary form. The case of a uniformly distributed load was examined in detail, and the possibility of obtaining a solution in the case of more complex load distribution is shown. Author

N64-30421 Joint Publications Research Service, Washington, D.C.

THE SOLUTION OF THE THREE-DIMENSIONAL PROBLEM IN THE ELASTICITY THEORY OF A CYLINDER

V. I. Makhovikov *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 24-33 refs (See N64-30416 22-33) OTS: $4.00

An exact solution is obtained for the three-dimensional stationary dynamic problem of the elasticity theory of an isotropic cylinder where the combined boundary conditions at the ends are fulfilled; this solution makes it possible to satisfy all the boundary conditions on the sides of the cylinder for displacements or for tensions. The solution is based on the representation of the functions found as Helmoltz differential operators and on the use of series. Author

N64-30423 Joint Publications Research Service, Washington, D.C.

DETERMINATION OF THE NATURAL VIBRATION FREQUENCIES OF CONTINUOUS PLATES

Zh. K. Makhortykh *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 47–51 refs (See N64-30416 22-33) OTS: $4.00

An asymptotic method for solving the problem of the vibrations of plates and shells is presented. The method does not have a strict mathematical foundation; its accuracy can be determined only through comparison with the results of identical problem solutions in those cases where such solutions can be mathematically constructed. A.W.

N64-30424 Joint Publications Research Service, Washington, D.C.

STRESS CONCENTRATION AROUND THE CURVILINEAR OPENINGS IN THE LATERAL WALL OF A CIRCULAR CYLINDER

A. N. Guz' *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 52–59 refs (See N64-30416 22-33) OTS: $4.00

The approximation method of constructing solutions for problems on stress concentration around curvilinear openings (elliptical, quadratic, and triangular with truncated angles) in a cylindrical shell is examined. The results are presented as differential and integral equations. Author

N64-30425 Joint Publications Research Service, Washington, D.C.

PLANE PROBLEM OF THE THEORY OF ELASTICITY FOR PLATES OF VARIABLE THICKNESS

Yu. P. Kochanov *In its* Eng. J., No. 2, 1964 16 Sep. 1964 p 60–73 refs (See N64-30416 22-33) OTS: $4.00

The problem of the stress state of plates of variable thickness is examined during the action of stresses in their planes. Basic equations are introduced that characterize the stress state of these plates. A solution is given for rectangular plates of variable thickness including tapering plates. The latter, in particular, are of interest for the construction mechanics of ships in connection with the consideration of plates of bulkheads, decks, and platforms under the action of stresses in their planes. Author

N64-30489 Lockheed-California Co., Burbank

DEVELOPMENT OF A POWER SPECTRAL GUST DESIGN PROCEDURE FOR CIVIL AIRCRAFT Monthly Report 1–31 Aug. 1964

F. M. Hoblit and N. Paul 8 Sep. 1964 90 p refs
(Contract FA-WA-4768)
(MR-6)

A qualitative check was made of the assumed atmospheric model being used in the establishment of gust criteria. Data on the dynamic analysis of vertical gusts are presented in tables. In the development of structural design techniques for a complete wing or other major component, two different approaches are emerging and are evaluated: (1) In the "design condition" approach, complete spanwise load distributions are generated that envelope the statistically defined loads at a number of points along the span. Phasing is established by matching certain select internal loads, such as beam shear flows. (2) In the "joint probability" approach, each element of the structure is examined separately. Where stress interaction is involved, as in combined shear and compression in a wing-surface panel, a joint probability density surface for the two stresses is established. The volume lying outside the cylinder defined by the interaction curve represents the probability that at any instant the limit or ultimate strength is exceeded. Also, work on the determination of design-type loads for stress analysis of reference airplanes is discussed. E.K.R.

N64-30496 California Inst. of Tech., Pasadena Firestone Flight Sciences Lab.

A METHOD OF DYNAMIC FRINGE PREDICTION IN BIREFRINGENT VISCOELASTIC MATERIALS

R. J. Arenz Mar. 1963 9 p refs
(Contract AF 29(601)-5367)
(GALCIT-SM-63-25; AD-439620) OTS: $1.10

Current research is directed toward a general verification of the validity of the use of linear viscoelastic materials in dynamic photoelastic testing. A situation that can be easily treated is a simple one-dimensional rod subjected to a step compression stress impact on the end. The verification will consist in comparing the theoretically predicted time-dependent fringe pattern with the experimental results for the same geometry and loading. The analytical portion of the study involves three basic phases: (1) theoretical solution for stresses in the rod due to wave propagation; (2) characterization of the appropriate time-dependent optical properties of the viscoelastic material used; and (3) prediction of fringes by means of superposition integrals involving the results of the first two phases. Author

N64-30526 Aerospace Corp., El Segundo, Calif.
INVESTIGATION OF THE DYNAMIC STABILITY OF A ROD
V. I. Weingarten 28 Feb. 1964 33 p refs
(Contract AF 04(695)-269)
(TDR-269(4560-40)-3; SSD-TDR-64-21; AD-603494)

The dynamic stability of a simply supported and clamped rod is investigated experimentally. Results indicate that large amplitude vibrations can be obtained in secondary regions of instability, as well as in the principal region. Author

N64-30532 California U., Berkeley Inst. of Engineering Research
SOME REMARKS ON THE LINEAR THEORY OF SHELLS
A. E. Green and P. M. Naghdi Apr. 1964 29 p refs
(Contract Nonr-222(69))
(AM-64-8; AD-603939)

Several aspects of the linear theory of thin elastic shells, which bear on recent developments of the subject, are dealt with in this paper. These include a further examination of asymptotic integrations of the three-dimensional equations of the classical linear elasticity theory and their extension to dynamic problems, a new derivation of the bending equations of shells and their reduction to the dominant terms of the asymptotic theory, and the problem of the edge effect. Author

N64-30545 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXV: METHODS OF MEASURING MECHANICAL PROPERTIES OF GRAPHITE IN THE 20° TO 2700° TEMPERATURE RANGE Technical Documentary Report, Jul. 1, 1961–Apr. 30, 1963
M. B. Manofsky and R. B. Dull Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1963 55 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XXXV; AD-601407)

This report describes methods and procedures for measuring short-time ultimate tensile, compressive, shear, and flexural (modulus of rupture) strengths of graphite, and the stress–strain relationships in tension, compression, and shear in the 20° to 2,700° C range. It presents also the description of a method being developed for determining Poisson's ratio in tension and compression at room and elevated temperatures. Author

N64-30555 Emmanuel Coll., Boston, Mass. Research Language Center
THE PROPAGATION OF LONGITUDINAL WAVES IN PLANE DISCS WITH A CIRCULAR HOLE [ZUR AUSBREITUNG VON STOSSWELLEN IN KREISLOCHSCHEIBEN]
Alexander Kromm Bedford, Mass., AFCRL, Oct. 1963 26 p refs Transl. into ENGLISH from Z. Angew. Math. Mech. (Berlin), no. 28(4), 1948 p 104–114
(Contract AF 19(604)-8505)
(E-T-G-63-30; AD-440905)

An investigation was conducted of the propagation of waves in a disc, caused by sudden rotary symmetric disturbance at the edge of a circular hole in the disc. It was assumed that there is a sudden outward radial force that is constant in time after its inception. It was shown that this disturbance propagated at a velocity $c = \sqrt{E/(1-\nu^2)\rho}$, i.e., with a wave front such that the jumps in particle velocity and tension decrease as $\sqrt{a/r}$. Here E is the modulus of elasticity, ν is Poisson's ratio, ρ is the density of the disc element, and a is the radius of the circular hole. Moreover, it was found that the ratio of the velocity jump to the tension jump depends only on the wave resistance $w = \sqrt{E\rho/1-\nu^2}$, as has been observed in other elastic processes. Further behind the wave front, the disc tends to a stationary state; in this case, to the rest state. Accordingly, the distribution of the displacements and the tensions tends to the case of static loading by the force at the edge of the hole. I.v.L

N64-30562 Purdue U., Lafayette, Ind. School of Aeronautical Engineering Sciences
STRESS WAVE PROPAGATION IN FINITE VISCOELASTIC THIN ROD WITH A CONSTITUTIVE LAW OF THE HEREDITARY TYPE
K. C. Valanis and S. Chang Jan. 1964 33 p refs
(Contract AF 94(611)-8539)
(A&ES-64-2; AD-602909)

The method of perturbation about a Maxwell body solution, which was used to analyze the wave propagation in a semi-infinite rod, is extended to deal with reflections of stress fronts at both ends of the rod. A numerical illustration of propagation of stress discontinuities in a finite rod made of polyisobutylene is included. Author

N64-30606* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
INTERPRETIVE REPORT ON CUMULATIVE FATIGUE DAMAGE IN THE LOW CYCLE RANGE
S. S. Manson Repr. from Welding J. Res. Suppl., Aug. 1964 p 1–9 refs
(NASA-RP-310)

Three methods—Manson's method, Fuller's method, and Valluri's method—for overcoming the limitations of the Palmgren–Miner method of determining linear cumulative damage are outlined. Manson's method is based on the hypothesis that prior fatigue history produces the effect of rotating the stress vs life curve rather than displacing it parallel to itself as required by the Palmgren–Miner hypothesis. Fuller's method is based on the empirical analysis of available cumulative fatigue data rather than on a foundation of rational analysis. The starting point of Valluri's analysis is a relation drawn from the dislocation theory. His analysis follows the crack from its initial size, associated inherently with the static ultimate tensile strength, via the Griffith equation, to its final size at which the applied maximum stress is sufficient to propagate the crack cataclysmically. Several research programs are suggested. I.v.L

N64-30621 Brown U., Providence, R.I. Engineering Materials Research Lab.
AN EXPERIMENTAL STUDY OF PLANE PLASTIC STRAINING OF NOTCHED BARS
W. N. Findley and D. C. Drucker May 1964 37 p refs
(Grant NsF GP-1115)
(EMSL-23)

Test results are presented for symmetrically notched 1-in.-wide steel and aluminum tension bars having a 0.30-in.-wide net section between sharp 90° notches. They show clearly that the limit load is close to the plane-stress value for a ratio of specimen thickness to net width of 1/2, and is but halfway to the plane-strain value for a ratio of 6. Strikingly different behavior is exhibited by the thin specimens of steel and aluminum. The apparent raising of the yield strength of aluminum but not of the steel is explained by reference to the difference between the Mises and the Tresca criteria of yielding. Special coupon tests in which plastic deformation is restricted to out-of-plane shearing demonstrate the validity of this concept. The great importance of concentricity of loading is shown, and the techniques of testing are described in considerable detail. Author

N64-30693 Watervliet Arsenal, N.Y. Benét R&E Labs.
EFFECT OF COUPLE-STRESSES ON FORCE TRANSFER BETWEEN EMBEDDED MICROFIBERS
M. A. Sadowsky, Y. C. Hsu, and M. A. Hussain Jun. 1964 42 p
(WVT-RR-6407; AD-603424) OTS: $3.00

The present report is a continuation of the Weitsman problem. The investigation is concerned with the nature of the stress field that develops in the presence of couple-stresses in composite material formed of microfibers embedded in a filler substance. The case is considered when one row consists of an infinitely long microfiber, and the second row is composed of two semi-infinite microfibers. An exact solution, based on a two-dimensional theory of elasticity with inclusion of couple-stresses is obtained for the stress field, which is activated by giving the two semi-infinite microfibers a tangential displacement of separation. The investigation led to results that are at wide variance with the Weitsman solution near $x = 0$, and the asymptotic solution shows the same trend as reported previously; i.e., bonding layers are dominated by boundary-layer behavior throughout their entire thickness. Author

N64-30707 Hayes International Corp., Birmingham, Ala.
TERMINAL BALLISTIC TARGET ANALYSIS AND STUDY OF TARGET VULNERABILITY TO VERY HIGH SPEED IMPACT Technical Documentary Report, 13 May 1963–12 May 1964
Eglin AFB, Fla., AFSC, Aug. 1964 100 p
(Contract AF 08(635)-3641)
(ATL-TDR-64-51; AD-447004)

Forty-nine targets of various metallic materials and of various configurations were examined to determine the effects of hypervelocity impact by aluminum projectiles on the targets. Targets were examined visually. Dimensions of perforations and craters made by projectiles of known mass and velocity were measured. Specimens from damaged areas were mounted, polished, and examined microscopically. The effects of hypervelocity impact were found to be confined to a narrow region around impact areas. The results of the target examinations are presented in this report. A consideration of new approaches to the analysis of the effects of hypervelocity impact on targets was made. The results of this work are discussed. Author

N64-30830* Measurement Analysis Corp., Los Angeles, Calif.
THE MEASUREMENT AND INTERPRETATION OF ORDINARY POWER SPECTRA FOR VIBRATION PROBLEMS
Allan G. Piersol Washington, NASA, Sep. 1964 54 p refs
(Contract NAS5-4590)
(NASA-CR-90) OTS: $2.75

This document discusses power spectral density functions from a practical engineering viewpoint with emphasis on applications to the analysis of flight vehicle vibration data. Analog instruments and techniques for measuring power spectra are outlined, and common measurement problems are considered. Fundamental interpretations for vibration data are stressed. Applications to structural vibration prediction problems are illustrated for simple cases from basic principles. Pertinent mathematical relationships are accompanied by appropriate expository material and detailed numerical examples. All necessary supporting developments and proofs are included. Author

N64-30909 Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
NONLINEAR THEORY OF STATIC STABILITY OF SHELLS
D. O. Brush [1964] 69 p refs Supplementary notes for lectures Presented at UCLA Short Course on Static and Dyn. Stability of Struct., Los Angles, 22 Jun.–3 Jul. 1964

The principal elements of nonlinear shell theory are described in relation to its use in shell-buckling analysis. The nonlinear differential equations of equilibrium and associated stability equations are derived for circular cylindrical shells. Certain well-known approximate solutions of the nonlinear equations for axially compressed cylinders are discussed, and a test program for assessing causes of low-buckling loads is reviewed. Initial imperfections and edge effects are considered as being two causes of discrepancies between theoretical and experimental buckling loads; the influence of both of these factors can be accounted for by nonlinear theory, and the exact solution of the nonlinear equations would result in close agreement between theoretical and experimental values. In practice, however, this procedure is prohibitively difficult, so that nonlinear theory cannot be used at present as a design tool for the direct determination of buckling loads. M.P.G.

N64-30914 Massachusetts Inst. of Tech., Cambridge
THE SPECTRUM OF RANDOM VIBRATION OF A NONLINEAR OSCILLATOR
Stephen H. Crandall Jun. 1964 28 p refs Presented at the 11th Intern. Congr. of Appl. Mech., Munich, 30 Aug.–5 Sep. 1964
(Contract AF 49(638)-1314)
(AFOSR-64-1057; AD-604047)

When a linear vibratory system is excited by a stationary random process the most useful statistical description of the response is given by either the autocorrelation function or the spectral density. The exact calculation of these statistics for a nonlinear oscillator remains an unsolved problem although a general approach has been outlined. This paper describes three approximate procedures that apply to systems only slightly nonlinear. The procedures are perturbation, equivalent linearization, and a new heuristic method based on simply averaging the deterministic properties of the nonlinear system. This latter procedure is an extension of the heuristic method recently introduced for obtaining the expected frequency of the stationary response of a nonlinear oscillator. It is shown that for vibratory systems with small stiffness nonlinearities all three procedures give autocorrelations (and spectra) that are identical to first order in the nonlinearity parameter. Author

N64-30917 Brown U., Providence, R.I. Div. of Engineering
A RAPID METHOD FOR ESTIMATING THE GREATEST STRESS IN A STRUCTURE SUBJECT TO CREEP
C. R. Calladine Nov. 1963 28 p refs
(Contract Nonr-562(20))
(TR-35; AD-429287)

Several simple structures made of material in which the creep strain rate is proportional to the nth power of stress are studied with a view to determining the way in which the greatest stress in a structure varies with the exponent n when the geometry of the structure and the load carried by the structure remain unchanged. From a study of the results, a simple empirical linear rule for interpolating for greatest stress between the specially simple cases $n = 1$ and $n \to \infty$ (which correspond to exact analogs of linear elastic and perfectly plastic material, respectively) is devised. The rule tends to be more conservative as n increases. The interpolation rule may be improved if a special linear-elastic thermal stress problem is solved. Author

N64-30927 Massachusetts Inst. of Tech., Cambridge Aeroelastic and Structures Research Lab.
THEORETICAL-EXPERIMENTAL CORRELATION OF LARGE DYNAMIC AND PERMANENT DEFORMATIONS OF IMPULSIVELY-LOADED SIMPLE STRUCTURES

Hans A. Balmer and Emmett A. Witmer Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., Jul. 1964 188 p refs
(Contract AF 33(657)-8427)
(ASRL-110-2; FDL-TDR-64-108; AD-605215)

A general numerical method previously developed for analyzing large, dynamic, two-dimensional deformations of simple structures (and of large, axisymmetric, dynamic deformations of plates and shells with rotational symmetry) has been extended and evaluated through comparisons of predictions with experimental dynamic response and permanent-deformation data from explosively loaded beams and circular rings. The method accounts for elastic, perfectly plastic, strain-hardening and strain-rate behavior of the structural material, and the experimental specimens employed were chosen to emphasize one or more of these characteristics and to provide tests of the adequacy of the theoretical prediction method. Author

N64-30934 Northrop Corp., Hawthorne, Calif. Norair Div.
SIMULTANEOUS APPLICATION OF STATIC AND DYNAMIC LOADS ON SONIC FATIGUE TEST ARTICLES. SUPPLEMENT I: CONSIDERATIONS OF THE THEORETICAL ASPECTS OF ACOUSTIC FATIGUE Technical Documentary Report, Jun. 1962–Jun. 1963
S. R. Valluri Wright-Patterson AFB, Ohio, Res. and Technol. Div., Jun. 1964 41 p refs
(Contract AF 33(657)-8757)
(NOR-63-196; RTD-TDR-63-4021, Suppl. 1; AD-605408)

A theory of acoustic fatigue is proposed that is based on a general theory of fatigue of metals. The theory is based on the proposition that the problem is better understood if attention is focused on the growth of the crack that is responsible for the ultimate failure. One significant manner in which the present theory differs from others is that it invokes a stress-dependent limiting condition on the crack growth to determine the cycles for failure. Crack-growth expressions are derived on a semi-intuitive basis, and these are used for defining equivalent damage at different stress levels. Representing the result of acoustic input as one of random stress response, expressions are derived for the prediction of time to failure. Author

N64-30963 Syracuse U. Research Inst., N.Y.
CRACK INITIATION IN CRYSTALLINE MATERIALS Interim Technical Report No. 1
P. Packman, K. Schroder, and V. Weiss Jul. 1964 111 p refs
(Contract NOw-64-0275-d)
(SURI-MET-1160-0764-IT; AD-602952)

The influence of several macroscopic and microscopic parameters on the fracture of crystalline materials has been studied on commercially pure tungsten, 2.5Al-16V titanium alloy and LiF single-crystal specimens. Test results showed that the continuum mechanical maximum stress theory predicts the correct behavior of these materials when surface preparation techniques are identical. Bend test results on LiF showed that small clevage cracks at the surface are not necessarily responsible for crack initiation. The actual dislocation process occurring at or near the surface was strongly dependent on the condition of the surface. Based on the equations of Neuber, the position of the maximum stress for an elliptical crack inclined at an arbitrary angle to the applied load was calculated. Author

N64-30990 General American Transportation Corp., Niles, Ill. MRD Div.
THE MECHANICAL BEHAVIOR OF FABRICS SUBJECTED TO BIAXIAL STRESS: CANAL-MODEL THEORY OF THE PLAIN WEAVE Technical Documentary Report, May 1963–15 May 1964
Dell A. Davidson Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1964 125 p refs
(Contract AF 33(657)-8479)
(ML-TDR-64-239; AD-605506)

This report presents the results of a theoretical and experimental investigation of the mechanical response of plain weave fabrics to uniform biaxial stress. A theory was derived to predict fabric strains and rupture, based on the use of a "canal" model of the weave, which characterizes the threads of the weave as round, inextensible, laterally incompressible, perfectly flexible, and frictionless. This model is more accurate than the usual "trellis" model of the weave, in which the threads are assumed to be straight and frictionlessly pinned at each thread junction. The canal-model theory of the plain weave was applied to all possible states of biaxial stress, and a FORTRAN program was written to compute fabric strains and rupture criteria for plain weaves of any dimensions. Author

N64-31094 Lockheed Missiles and Space Co., Sunnyvale, Calif.
BUCKLING OF AXIALLY LOADED CYLINDRICAL SHELLS
B. O. Almroth and D. O. Brush [1963] 28 p refs Presented at the Lockheed Missiles and Space Co. Conf. on Shell Theory and Analysis, 21–23 Aug. 1963
(LMSC-6-90-63-77)

The severe discrepancy between theoretical and experimental results for the buckling load of axially compressed cylinders is well known. This paper presents results of a test program specifically designed to throw some light on the causes of the discrepancy. The results indicate that minimization of initial imperfections in the test specimens greatly increases the buckling load, that the buckling load under usual laboratory conditions depends on the properties of the test specimen itself rather than on the testing environment, and that the buckling loads under deadweight and controlled end-shortening conditions are the same. Also presented are results of postbuckling equilibrium analyses of core-filled cylinders, pressurized cylinders, and certain types of orthotropic cylinders. Author

N64-31119 Pratt and Whitney Aircraft, East Hartford, Conn.
DYNAMIC THERMAL AND PRESSURE STRESSES IN THIN SPHERICAL SHELLS Final Report
H. Kraus 31 Aug 1964 7 p refs
(Contract DA-31-124-ARO(D)-146)
(PWA-2386; AROD-4367-2; AD-446491)

Calculation of the response of nonshallow spherical shells to suddenly applied heat inputs is discussed. The effects of inertia are included, and as a result the problem is considered as a problem of forced vibration analysis of a suddenly heated shell. The method of solution of the forced vibration problem of a nonshallow spherical shell is based on expansions of the dependent variables in series of normal modes, which are obtained from a free vibration analysis. P.V.E.

N64-31120 General Electric Co., Philadelphia, Pa. Missile and Space Div.
HYPERVELOCITY IMPACT CALCULATIONS AND THEIR CORRELATION WITH EXPERIMENT
T. D. Riney and J. F. Heyda Eglin AFB, Fla., Res. and Tech. Div., Sep. 1964 69 p refs
(Contract AF 08(635)-3781)
(ATL-TR-64-64; AD-446745)

Additional calculations are presented confirming a previous conclusion that in a thick target the depth of penetration of geometrically similar projectiles of like metal varies with the impact velocity according to $v_0^{2/3}$ in the hypervelocity regime. Calculations are also given showing that the crater dimensions

are relatively insensitive to the density of homogeneous projectiles. Experimentally observed size effects are discussed in terms of the viscoplastic model, and it is concluded that the threshold velocity for energy scaling will depend somewhat on the dimensions of the projectile. Finite plate calculations are presented for several plate thicknesses. Moreover, the spatial divergence of the spallation bubble and the corresponding decrease in the momentum density are obtained as a function of the standoff distance for two impact situations. Preliminary calculations are also included for impact into a target consisting of two spaced plates. Author

N64-31203* Astro Research Corp., Santa Barbara, Calif.
THE UNIFORM-STRESS SPINNING FILAMENTARY DISK
A. C. Kyser Washington, NASA, Oct. 1964 23 p refs
(Contract NASw-652)
(NASA-CR-106) OTS: $0.75

An analysis is presented for the development of the fiber patterns necessary to produce uniform fiber tension in a spinning filamentary disk. The family of fiber patterns for such isotensoid disks is described in terms of curvature, slope, and arc length, and means are suggested for obtaining polar-coordinate plots of the patterns. Included are diagrams of three of the patterns, a photograph of a model, and a discussion of the general characteristics of the family of allowable patterns. It was found that the isotensoid disk design with which the disk is covered by uniform-diameter fibers operates at half the stress of a simple hoop, for a given tip speed and fiber mass per unit length. Author

N64-31227 Watervliet Arsenal, N.Y. Benet R&E Labs.
RESIDUAL STRESSES IN THICK-WALLED CYLINDERS RESULTING FROM MECHANICALLY INDUCED OVERSTRAIN
T. E. Davidson, D. P. Kendall, and A. N. Reiner Sep. 1963 39 p refs
(WVT-RI-6319; AD-421194)

Autofrettage is a process for inducing elastic response in thick-walled cylinders subjected to internal pressures that otherwise cause plastic strains. To extend the use of autofrettage to higher pressure applications and to eliminate many of the problems encountered in the use of the conventional process based on the use of direct internal hydrostatic pressure, a new technique has been developed that utilizes the mechanical advantage of a sliding wedge to produce the desired bore enlargement. Since the use of a sliding wedge or mandrel will induce shearing forces at the mandrel–cylinder interface, the resultant residual stress distribution will differ from that theoretically predicted as characteristic of the direct hydrostatic process. It is the purpose of this work to determine the residual stress distribution as a function of magnitude of overstrain and diameter ratio, and how it affects the reyielding characteristics of cylinders autofrettaged by this technique. Author

N64-31235 Boeing Co., Seattle, Wash. Aerospace Div.
NEGATIVE EQUATION OF STATE AND SPALL CRITERIA
Technical Documentary Report, May 1962–Jun. 1963
J. R. Penning, Jr., D. M. Young, and J. H. Prindle Kirtland AFB, N. Mex. Res. and Technol. Div., Sep. 1963 159 p refs
(Contract AF 29(601)-5363)
(RTD-TDR-63-3039; AD-420509)

Several types of solids have been subjected to high, one-dimensional, short-duration strains produced by the planar impact of flat plates accelerated either by electrically exploded metal foils or by an air gun. Time-to-spall measurements have been made at room temperature on Plexiglas and aluminum. The critical tensile stress was found to depend on the time duration of the pressure pulse in aluminum but not in Plexiglas. The critical spall threshold in Plexiglas was found to increase with increasing temperature: 1 kilobar at room temperature, 1.5 kilobars at 68° C, 2 kilobars at 100° C. The Hugoniot equations of state for Plexiglas have been measured at 68° and 100° C, and for chopped nylon phenolic at room temperature and at 100° C. The free surface velocity in chopped nylon phenolic, as well as in Plexiglas at sufficiently high velocity, has been shown to drop off with distance at a much higher rate than predicted by simple hydrodynamic theory. As a result, a critical tensile stress cannot be defined in chopped nylon phenolic. Author

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-30464 Telecomputing Corp., San Diego, Calif.
OPTIMUM FILAMENT DIAMETER Quarterly Report, 20 Apr.–20 Jul. 1964
J. Jobaris 20 Jul. 1964 26 p refs
(Contract NObs-86347)
(QR-8; AD-443598)

A sandwich cylinder employing a new design concept developed for 5-mil E-glass fibers was fabricated and tested in hydrostatic compression. The cylinder collapsed at a pressure of 11,500 psi from local instability in the core structure. This has been corrected by experimental design, and a revised cylinder is under construction. Author

N64-30537 Aeronca Mfg. Corp., Middletown, Ohio
HEAT SHIELD CONCEPTS AND MATERIALS FOR REENTRY VEHICLES
W. Niehaus, ed. 15 Jul. 1963 66 p refs
(Contract AF 33(657)-7151)
(AD-439449) OTS: $6.60

Discussed are thermal protection systems and thermantic structures developed to withstand temperatures in excess of 3,000° F for extended periods of time (approximately 1 hour) and to resist the severe noise and dynamic loads associated with space-vehicle flight. A heat shield was developed that consists of a low-density ceramic foam reinforced with a honeycomb cell structure; it is capable of maintaining an internal temperature suitable for the survival of both man and sensitive equipment. The thermantic structure uses a conventional load-bearing panel fabricated from alloy sheets brazed to stainless-steel honeycomb, and the load bearing panel is, in turn, brazed to a ceramic honeycomb reinforcement. The concept of the heat shield, along with its composition and capabilities, is discussed. P.V.E.

N64-30911 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DESIGN OF HIGH TEMPERATURE STRUCTURAL SYSTEMS
M. A. Steinberg and H. P. Kerfoot Sep. 1963 48 p refs

The general environmental and material considerations necessary for design are briefly reviewed. Advanced nonmetallic structural material concepts are presented with their applications. The superalloy materials are discussed and compared on a structural efficiency basis with other materials, and the

present status of the refractory metals is evaluated. Consideration is given to a selected group of composite material systems and materials for use in nozzle and insulative applications. Special emphasis in these latter areas is in the chemical and thermal response of the materials. Author

N64-31185 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

THE OPTIMIZATION OF SIMPLY-SUPPORTED BEAMS FOR MAXIMUM FUNDAMENTAL FREQUENCY, GENERAL MODEL

W. C. Loomis Jul. 1964 98 p refs
(SM-47674)

A procedure for determining the optimum shape of a symmetrical beam for maximum fundamental frequency-to-mass ratio is presented. The method is derived for two types of cross-sectional variation along the span: (1) one cross-sectional dimension remaining constant, and (2) the cross-sections at all stations being geometrically similar. By considering cross sections where both the area and moment of inertia can be expressed as a function of radius of gyration only, the results are obtainable in nondimensional form. Such a formulation allows the solutions for both types of variations to be applicable for a variety of cross sections. The case of a simple supported beam is analyzed numerically. It is shown that the frequency-to-mass ratio for the optimum beam is greater than three times that of a uniform beam for both types of cross-sectional variations treated. Author

N64-31248 Goodyear Aerospace Corp., Akron, Ohio Methods and Materials Div.

STRUCTURAL FABRIC PROGRAM Interim Technical Progress Report, 1 Jul.–30 Sep. 1963

J. O. Miller [1963] 24 p
(Contract AF 33(600)-43036)
(ASD-TR-7-904(IX); AD-420474)

Discussed is the testing, assembly, and erection of a loom and the associated machinery and processes capable of producing metallic AIRMAT fabrics of the size, quality, and shape required for reentry vehicle applications. The loom is to have the capability of weaving shapes such as open end tubes, cones of different angles, and curved surfaces of different radii of curvature, such as ellipses and parabolas. P.V.E.

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